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Psycholinguistic coherence of emotion states.

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PSYCHOLINGUISTIC COHERENCE OF EMOTION STATES

By

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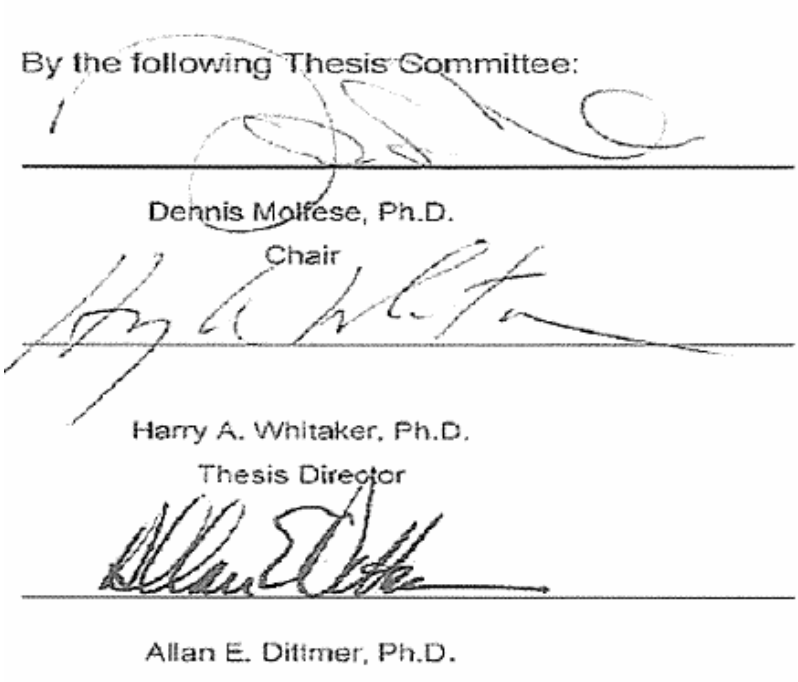

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Abstract

PSYCHOLINGUISTIC COHERENCE OF EMOTIONAL STATES

Jim A. Yockey

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How do words represent emotional states, and how closely are they clustered to an actual emotion? Opinions vary as to how many emotions there are, and whether (or which) emotions are basic. Generally, many agree that basic emotions include fear, anger, joy, sadness, and disgust. Some researchers include surprise, shame, interest, and others as derived emotions. However, all proponents of basic emotions confirm that each emotion reflects a unique motivational and behavioral tendency. These basic emotions are significant in that they represent distinct modes of action and are physiologically distinguishable. Yet, what of the myriad of other words humans use to describe those same emotions? Curiously, many researchers, including neuroscientists, have approached this topic without understanding how well “representative language” describes emotional states. This question prompts my inquiry of how closely correlated emotionally descriptive words are to each other.

This study design is a triadic comparison of selected emotion words in two studies; a Positive/Negative word mix, then all Positive or all Negative word presentations to volunteer subjects. The purposes and outcome parameters of this research is to explore how emotion words actually cluster. Utilizing an online survey questionnaire, subjects were presented ten emotion words, three at a time, from which they were asked to select the two most similar. An important

aspect of these studies was also to ascertain the efficacy of a triadic comparison, and the subsequent utility of Hierarchical Cluster Analysis in explaining results. The study population is generally described as university students, along with other volunteers to whom the study is interesting. Subjects are, in aggregate, considered to be somewhat representative of the larger population of like age, education, and background in the United States.

The results were consistent in revealing coherence of emotion words and, ultimately, suggested improved methodology protocols for future investigations. While coherence was detected, often the logic of the connection among some emotion words was difficult to explain when subjects viewed a mixture of positive and negative words. Selecting from only positive or negative emotion words provided a more coherent clustering. The utility of triadic comparisons and Hierarchical Cluster analysis in determining what emotion words fit together was shown to be a useful research method for this kind of study.

To reach an understanding of emotions and emotion states, research must include knowledge of the psycholinguistic structure and coherence of these emotion states. This study should prompt additional research to determine how emotion words relate and cluster to "core" or "basic" emotions similar to the ones mentioned above.

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Introduction

The study of human emotion has intrigued philosophers, psychologists and other scientists for centuries. Today, even with the assistance of technology, emotions are still largely a mystery. Curiously, many researchers, including neuroscientists, have approached this topic without a complete understanding of how well “representative language” describes emotional states. If one assumes that emotions are such things that are stable, consistent, coherent states, and that language reflects these emotional states (a vocabulary set of words reflective of these states), then the importance of knowing how words represent these states and how closely they cluster together around the actual emotion, is elevated. In literature, philosophy, education, neuroscience, no one knows how well these words reflect the actual emotion, i.e., how far are the descriptive words from the core concepts and how do the words cluster together in describing emotion constructs or states.

Primarily, an emotional state has a stimulus that results in behavior, whether that is physical actions, internal thoughts, or, importantly, decisions on that action. Emotions require expression which come verbally, through our posture, variations in facial patterns, alterations of our activity, and have, for a long time, been associated with the chemistry of the human body. Think of it this way, we give three obvious readouts of emotions, biological changes (e.g. adrenaline rush), our subjective awareness of the emotional state (focused attention internally, like frustration or depression), and the public display of the emotion (e.g. pulse rate, face flush, breathing). Each is linked by thought to some form of motivation or action, and is predominantly identified through language.

Opinions vary as to how many emotions there are, and which emotions are basic. Indeed, many researchers debate the existence of “basic” emotions. Most agree that basic emotions include fear, anger, joy, sadness, and disgust; some researchers include surprise, shame, interest, and others as derived emotions.

However, all proponents of basic emotions agree that each emotion reflects a unique motivational and behavioral tendency. The basic emotions are significant in that they represent distinct modes of action and are physiologically distinguishable (at least testable). But, what of the myriad of other words humans use to describe those same emotions? The question prompts this inquiry of how closely correlated these words are, and prompts the exploration of how they are representative of a positive or negative emotion.

A number of researchers have studied the phenomenon of emotions, joined by a growing list of neuroscientists aided by imaging technology. Language is a functional and an integral component of the majority of this work, although approaches and theories differ in meaningful ways. The following are selected examples of research on the emotion.

“Emotions are part of the biological solution to the problem of how to plan and to carry out action aimed at satisfying multiple goals in environments which are not perfectly predictable. Emotions are based on non-propositional communications which we will call 'emotion signals'. They function both to set the whole system suddenly into a particular mode, and to maintain it tonically in that mode. Emotion signals provide a specific communication system which can invoke the actions of some processors and switch others off." (Oatley, K., and Johnson-Laird, P. N. 1987. Towards a cognitive theory of emotions.) This is similar to the operating program in a computer that directs information traffic. According to Oatley and Johnson-Laird there are two kinds of communication. The first is the actual information we process and the second is emotional in nature. The second task is not to convey information but to shift our system into a state of increased attention, the so-called emotion mode. We humans respond by inducing, mostly subconsciously, a feeling or emotion to evaluate and deal with the information received. Basically, the information and the emotions intersect this way:

Table 1

Perception from Information	Emotion
Goals being achieved	Happiness
Failure of major plan or goal not met	Sadness
Self-preservation- goal violated	Anxiety
Active plan frustrated	Anger
Goal violated	Disgust

- "Emotions constitute the primary motivational system of humans. Each of the primary emotions (joy, interest, surprise, fear, anger, distress, contempt, disgust, and shame) supplies its own unique kind of motivating information." (Silvan Tomkins University of Pennsylvania MA in psychology, doctorate in philosophy.) In the early 1960's, in his *Affect Imagery Consciousness*, Tomkins departed from mainstream psychology to declare the predominance of the affect system (motivating forces) in human life. Basically he said that what humans know (through perception, reasoning, or intuition) involves the motor system, our system of perception, and our memory. When you add language to the equation you have a process through which the affect is linked to past experiences. The emotion attached to the experience forms a script or model we reuse knowingly.

- Robert Plutchik Ph.D. (Columbia University) is professor emeritus at the Albert Einstein College of Medicine and adjunct professor at the University of South Florida. He argued in *Emotion: theory, research, and experience* (New York: Academic Press, 1980) that mental evaluations always precede emotions and may be based upon information provided internally or externally. Plutchik used a multi-dimensional model to classify emotions according to their similarities (Figure 1 illustration shown, The Emotions: Facts, Theories, and a New Model, 1962, p. 111). Subjects were given pairs of emotion describing words and asked to rate their similarity. From these

judgments a map of emotions emerged, and were arranged as: Primary, Secondary, and Tertiary emotions. Plutchik points out that an emotion is not simply a feeling state, it is a complex chain of connected events, beginning with something that stirs us up, induces feelings and psychological changes, and then urges us to action. In other words, feelings do not happen in isolation. They are responses to significant situations in our lives, and many times motivate actions. He listed eight basic emotions associating them with behavior. But, he concludes, the basic emotions are composed of more complex emotions acting as a kind of feedback loop to our behavior.

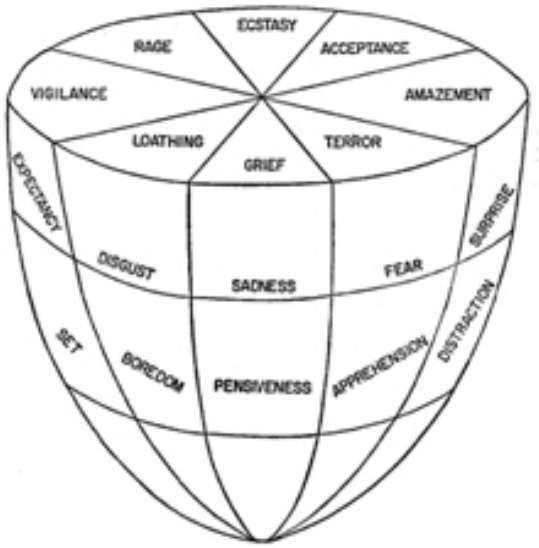


Fig. 1 A MULTI-DIMENSIONAL MODEL OF THE EMOTIONS

Plutchik Study:

For the judged intensity of emotion terms:

First round of study: 30 college students were presented a list of synonyms of emotion words from the Roget's Thesaurus told to examine the entire list and rate them in terms of the degree of intensity that they represent (scale 1-11). The mean judged intensity obtained for each term of the eight primary emotion dimensions, as below:

Dimensions (note mean of scale 1-11, with 11 being most intense)							
Destruction	Reproduction	Incorporation	Orientation	Protection	Deprivation	Rejection	Exploration
Rage (9.90)	Ecstasy (10.0)	Admission (4.16)	Astonishment (9.30)	Terror (10.13)	Grief (8.83)	Loathing (9.10)	Anticipation (7.30)
Anger (8.40)	Joy (8.10)	Acceptance (4.0)	Amazement (8.30)	Panic (9.75)	Sorrow (7.53)	Disgust (7.60)	Expectancy (6.76)
Annoyance (5.0)	Happiness (7.10)	Incorporation (3.56)	Surprise (7.26)	Fear (7.96)	Dejection (6.26)	Dislike (5.50)	Attentiveness (5.86)
	Pleasure (5.70)			Apprehension (6.40)	Gloominess (5.5)	Boredom (4.7)	Set (3.56)
	Serenity (4.36)			Timidity (4.03)	Pensiveness (4.4)	Tiresomeness (4.5)	
	Calmness (3.3)						

Plutchik, The Emotions, Facts, Theories and a New Model, Random House, NY, 1961, p. 114

Table 2

Note the qualifier stated: “The question of the exact form of the emotion-solid is an empirical problem which can be answered only by studies of level of arousal of the primary emotions. Since this is a subjective problem as well as a behavioral and physiological one, any one study of intensity of the primary emotions will provide only an approximation to the structure.” (Plutchik, The Emotions, Facts, Theories and a New Model, Random House, NY, 1961, p. 112)

Plutchik indicated in this study, admittedly a hypothetical construct, that five of the emotions showed maximum intensities and provides an approximation for the shape of his emotion-solid. The relationships indicated by the mean responses form dyads and triads of emotions in his visual representation, with the lower portions less well connected by intensity.

In a second experiment, Plutchik attempted to construct a method of naming emotion mixtures corresponding to the “emotion-solid”. This was accomplished through two methods, the first of which was discounted due to the introspective synthesis of the primary emotions. The second method was relied upon. This component featured the presentation of a long list of emotion-names to a group of 34 judges, asking them to indicate which of the primaries were present. The

results listed terms appearing frequently in Primary, Secondary, and Tertiary Dyads of these words. An example:
Anger + joy = pride;
fear + disgust = shame, prudishness.

These combinations led the examiners to conclude that, of the emotion words described, the implication was “any combination of emotions which are nearly opposite leads to greater conflict and immobilization than combinations of adjacent emotions.” (Plutchik, p. 119)

Further studies attempted to analyze emotion words by observing facial expressions, somewhat reminiscent of the work of Paul Ekman (books in print: Emotions Inside Out, 2003;Emotions Revealed, et.al.) and even more recent fMRI studies using a similar, subjective method to identify the mysteries of emotion processing. *(See: Elevated responses to constant facial emotions in different faces in the human amygdala: an fMRI study of facial identity and expression;Jan Gläscher* 1 , Oliver Tüscher* 1, 2 , Cornelius Weiller1 and Christian Büchel1;1Neuroimage Nord, Department of Neurology, University Hospital Hamburg-Eppendorf, Martinistrasse 52, 20246 Hamburg, Germany 2Functional Neuroimaging Laboratory, Department of Psychiatry, Weill Medical School of Cornell University, 1300 York Ave, New York, NY, 10021, USA, BMC Neuroscience 2004, 5:45)*

• Elegantly, Antonio Damasio M.D., Ph.D. explained the richness of our emotions and feelings at a lecture in 2003. (Becoming Human: Brain, Mind and Emergence, Stanford University, 2003). Damasio, a prolific neuroscience writer and Head of Neurology at the University of Iowa, said that emotions are packages of solutions (ingredients of an emotional event as a set of actions or reactions) involved in problem solving.

These packages are broadly related to the management of life, and are routines for addressing certain problems we face or opportunity taking (reward/punishment mechanisms) useful to us. Feelings are mental maps and

are representations of emotions. We can emote without feelings, but together they form a concert of behaviors. There is a large compass of emotions, many (e.g., background emotions like encouragement, hopefulness, guilt, wonder, sympathy, empathy, compassion, awe) are extremely complex and do not disappear quickly like primary emotions (fear, anger). These background emotions have social, cultural implications, in relationship to others in our environment, and, like all emotions, produce behavior. To distinguish and support this observation, Damasio says “Our genome does not carry ‘ethics’ as a gene.” Many of these are learned emotions via association, modeled in a rich way, and are shared universally among all humans.

Damasio suggests that there is a process at work. First is the Evaluative or Appraisal (conscious or not) Stage, which causes a change in brain systems and introduces options for behavior. Some options are automatically acted upon (fight or flee); some are thoughtfully considered in the frontal lobe where a higher level of complex emotions are processed. Second step of the process is the Execution of Emotion Stage involving the brain stem and hypothalamus, then onto the rest of the body for action.

This progression, stimulus/emoting/feeling, allows us to know what our body is doing at the time through neural maps (state of life within); feelings reveal “good for life states or not for good life states.” This may be a “sixth sense” dedicated system, to monitor the state of the body and even our internal chemistry. Feeling our own body uses certain internal parallel channels that may be dedicated for that purpose. Humans can also do this without external stimulus. We can think about a memory of a difficult event, for example, which can bring on a feeling. Further, we can use our knowledge to evaluate feelings to rationally determine how sound they are, or their acceptability to society. William James and Sir Charles Sherrington alluded to these overlapping neuronal fields as possibilities in the late nineteenth and early twentieth century.

Thesis Statement

Irrespective of theories of what process humans use to effect emotions, to reach an understanding research must include knowledge of the psycholinguistic structure and coherence of emotion states. That is the basis of my research. To restate, my hypothesis is that, in the studied subjects, emotion words cluster together in an interrelated way, some more closely associated than others with the actual human emotion. The assumption is that emotions are stable, consistent, coherent states, and that a vocabulary set of words reflect these emotional states.

Approach and Methods

The purpose of this research was to discover, empirically, how emotion words actually cluster by researching the question. The empirical data was the product of Hierarchical Cluster Analysis (HCA). These analyses are relevant and useful to anyone doing research with emotion words. The analysis should indicate to researchers what words are associated closely together as representing Positive and Negative emotions. This is opposed to the current method of subjectively deciding what emotional state is to be represented, with some hope that the subject can attain the state internally.

Procedure for Collecting Data

The Population

The population is generally described as university students, along with other volunteers to whom the study was interesting. The study was considered to be somewhat representative of the larger population of like age, education, and background in the United States, although this is not empirically confirmed herein.

The Samples

Subjects were invited to participate in this research study generally by verbal request through announcement in classes and by posting on campus bulletin boards. In the first survey, a sample of 194 first or second year undergraduate students, master's students in psychology, and 14 other volunteers, randomly asked to participate. The administration concluded with 130 cases of completed survey's, and 64 cases with little or no useful data.

In the second survey, 139 respondents, from the same sources noted above, were administered the online instrument and completed it fully.

Demographic information follows:

Table 3

Education	**44.3% in college**	**2.1% Grad school and .7% PhDs.**
Age Range	**66.9% under 20**	**28.9% 20-30**
Major	**38% in Nursing,** **2.7% Psychology**	**8.8% Liberal Arts 4.9% Social Work**
Gender	**76.1% Female**	**23.9% Male**
Current Emotional Feelings	**Good 73.9%**	
Typical Emotional Feelings	**19.7% better usually**	
Ethnicity	**89.4% Caucasian**	**4.2% African American**

The estimated sample size for this study is based upon the generation of triadic comparisons sufficient to present all of the possible combinations (9880) of 40 chosen emotion words. This entailed each subject, viewing 10 words in all combinations, be presented 120 triadic comparisons. In order to develop a sufficient database, 82.3 subjects were required for each of the two studies. Although the participation exceeded our sample estimate, an even larger database of comparisons would likely increase the confidence levels in the cohesion of the chosen test words. For clarity, of the 40 emotion words selected for each of Study of the study a total of 9,880 viewings of triadic comparisons were required and administered as follows:

- 120 viewings per subject at 10 words per group results in 9,880 comparisons;
- 82.33333333 subjects required for the 9880 total viewing selections (9880/120).

Research Design

Triadic comparisons of emotion words were presented to subjects who anonymously logged onto a specified Website provided by the researcher (emetricsresearch.com). A prepared list of emotion words to be tested was selected both from the literature researched and with some subjective bias. The literature search identified 142 emotion words that had been the subject of study, to which were added 11 words of interest (see Appendix). In order to reduce the subjectivity, however, the 153 words from the compiled list were randomly sorted (using methods described below), then a total of 40 words were chosen (scrubbed) to equally depict positive and negative emotion state tendencies.

The resulting lists consist of 40 emotion words divided into 4 sets of 10 each, with an equal number of positive and negative words for Study 1. In Study 2, these 40 words (4 sets of 10 words) were reallocated, resulting in two positive word groups and two negative word groups. The researcher notes that, of the selected words, some may demonstrate tendencies more obviously toward positive or negative emotions, what could be described as neutral words, and are not as clearly categorized as are some positive/negative descriptors. This is an important distinction of this study; to show the relative cohesion. Each subject selected words from random triads presented through the following assembly method:

- Of the 40 words, 4 groups of 10 words were constructed available for administration to subjects in triads. Each of these groups had been randomly populated with the emotion words, five “positive” and five “negative” for Study 1 and 10 “positive” or “negative” for Study 2.

- Each of the 4 groups was assigned to subjects in order of login. (Group 1 to Subject 1, Group 2 to Subject 2, and so on. Subject 5, for example, was assigned Group 1, to start the stepped process over again.) The presentation order of the words for each subject to select from the Triadic Response Screen was also randomized.
- Upon selection of the two most closely related words in each Triadic Response Screen (TRS), another triad set of randomly presented words was displayed, allowing the subject to select, again, the two that most closely represent similar emotions. Each subject tested ten emotion words totaling 120 triadic presentations representing all possible combinations, resulting in the collection of a “cluster” of words for analysis.
- Each Group of 10 words was tested in stepped rotation (1-4), resulting in a requirement of at least 82.3 subjects for each Study; each Word Group was tested by different subjects, as below:

Study 1:	Study 2:
Word Group 1- 34 subjects	Word Group 1- 36 subjects
Word Group 2- 31 subjects	Word Group 2- 30 subjects
Word Group 3- 35 subjects	Word Group 3- 37 subjects
Word Group 4- 30 subjects	Word Group 4- 36 subjects

Table 4- Subjects by Word Groups

Selected Methodology

For further clarification of the chosen methodology, each of the 40 words has been used in some kind of emotion study revealed in the literature research and were drawn subjectively. The "proof of concept" intention of the thesis was to discover the "clustering" of these words, as well as to determine the efficacy of triadic comparisons . This could be compared to the existing research available on the clustering of emotion words.

For each "Group" a quasi-random selection was made in the following way:

1. Numbers were assigned to each word (1-40), the random generator was constructed from which a random number representing the corresponding word was produced;
2. a total of 4 groups of these “new” random numbers was constructed, consisting of 10 random numbers in each group;
3. then, within these matrices of the 4 groups, each containing 10 cells with the random number, the number was replaced by the corresponding word.
4. Once this 4 x 10 grouping was completed (possible 120 triadic combinations in each) the lists in each Group were scrutinized to assure that no group contained duplicate words (if duplicates were discovered an additional random number was generated and the word replaced). The procedure for substituting an under-used word was a continuation of the above quasi-randomization, and was accomplished by arbitrarily selecting a cell with an over-used word within which to make the substitution.
5. Further, the 4 groupings were reviewed to make sure all of the 40 words were used in the 4 Groups.
6. Finally, the Groups were reviewed again for duplication. None was found.

Note that a mathematical formula in Microsoft Excel for randomization called Mersenne Twister Algorithm was used. The Mersenne Twister is an algorithm for generating random numbers. It was designed with consideration of the flaws in various other generators. A more complete description may be found in the Addendum.

The web survey instrument (program) was designed to assure that all Groups of words were administered to subjects in sequential order (Subject 1-Group 1, Subject 2-Group 2, and so on) as they logged onto the site. The study required at least 83 subjects. The number of triads in each Group was calculated to be 120,

making the total administration of 120 triadic selection screens to each subject. The subject was able to finish within ½ hour.

The survey (instrument) program, written in Visual Basic 5.0 and Macromedia Flash, systematically presented the Word Groups containing the aforementioned emotion words to each subject, then randomly presented the 10 words in that Group in triads. The method for randomly presenting the 10 words, 3 at a time, was accomplished by assigning each word in the Group a number, then, using the Mersenne Twister Algorithm, generate the 120 possible combinations. Each of the triads were then randomly administered until all 120 possible combinations were viewed. At the conclusion of the survey of 120 comparisons for each subject, the resulting word pairing count was reported to an Excel spreadsheet along with a subject ID. The ID was generated as the subject consented, having read the agreement prior to beginning the survey. This ID number was a random assignment without any personal, identifying information and it contained the Word Group number presented to that subject. That spreadsheet report was either automatically emailed to jayock02@louisville.edu or made available for secure download from the website. (Representative Website screens are included in the Addendum.)

The individual data was aggregated into a single spreadsheet by Word Group and then imported to SPSS for analysis. Hierarchical Cluster Analysis (HCA) was chosen as the final statistical methodology. This is a multivariate procedure (algorithm) useful in determining natural homogeneous groups of data (similarity characteristics). The procedure requires a priori decisions as to the number of groups of interest and definitions (rules) of similarity. *Since HCA is considered an "exploratory" procedure. As such, it is not accompanied by statistical significance testing.* Additional study may find utility in more traditional testing methods. Within the statistical program SPSS, the amalgamation linkage process found most representative was Ward's Method, and the measurement method determined was Manhattan (City-block) distance.

Finally, the demographic information was collected, transferred to SPSS for each subject (no identification of any kind was required). Again this was accomplished with the same delivery options as above.

Procedure Review:

1. The Triadic Response Screen (TRS) [see Addendum] was used for input; subjects viewed the TRS on-screen, on the web site. Another goal of the programming portion of the project was to create a TRS such that the output of each subject's TRS went into the Excel 10 x 10 matrix and to an aggregated spreadsheet, combining subject responses.

2. Functioning of TRS. The subject saw the three choices; only one button could be illuminated (on); hitting the "Next" button cleared the TRS, sending the choice to the 10x10 matrix and then the next TRS appeared.

3. A list of 10 words makes a 100-cell matrix (10 x 10); in each cell is a count of the number of times a word in the ordinate column is matched to a word in the abscissa column; for an N of 10 (the scale from 0 to 10 is a scale of the strength of the clustering or match for any word pair). The matrix is logically divided with the top half (fold) containing the useful pairing count.

Example Matrix (one subject, one word group):

EmotWord	angry	anxious	disgusted	excited	happy	loving	nervous	sad	surprising	trusting
angry	0	103	72	100	70	99	79	90	96	99
anxious	0	0	99	101	92	87	94	79	80	90
disgusted	0	0	0	85	94	91	95	93	78	104
excited	0	0	0	0	92	89	92	79	90	91
happy	0	0	0	0	0	98	97	96	92	84
loving	0	0	0	0	0	0	91	79	102	93
nervous	0	0	0	0	0	0	0	88	87	95
sad	0	0	0	0	0	0	0	0	86	99
surprising	0	0	0	0	0	0	0	0	0	90
trusting	0	0	0	0	0	0	0	0	0	0

4. 10 x 10 matrix was saved in an Excel file which was input into the SPSS statistics program.

   (a) Programming: the number of triads per number of items in the list is fixed and each triad was created the same way for every list. Randomization occurred when:

   - All the TRS's were created for a word list of N length (previously discussed) for each Group.
   - After the Groupings of TRS's were created and Group selected, the words of a triad were put into their TRS so they would randomly appear on-screen for a subject's response.
   - In the diagram example (Addendum-Survey Screen Examples), words 1 and 3 of the triad are the first choice; on the next triad, words 3 and 5 might be the first choice, and so on.

   (b) **Summary of randomization:**

   i. Randomized (quasi) word Groupings within elements;
   ii. word groupings selected sequentially for presentation;
   iii. randomized how triad was displayed on TRS.

Definitions

- Triadic combinations.

List of words administered to each subject, maximum of 10 words in each Group which form a possible 9,880 triadic combinations. The number of triads is calculated using:

$$C_{k,n} = \frac{n!}{k!(n-k)!}$$

Where C is the number of combinations of 10 words, k = 10 (the number of available words in each group); n = 3 (the number of words required) resulting in 120 possible triads for each subject. Using the same formula, 40 words, in triads, would form 9,880 combinations. Thus, 9,880 triads divided by 120 presentations equals 82.33 subjects for each survey Study.

- Randomization.

Randomization is an important issue to address. First, it was known that the randomization must account for the presentation of all 40 subjectively selected

words without duplication within groups. To assure this randomization, the following steps were used:

- Each of the test words was assigned a number (1-40) and the numbers were randomized using the selected formula.
- This resulted in a new random number assignment for each word.
- This list was sorted in ascending order forming a mixed list of the 40 words.
- This sorted list was randomly assigned a Group participation (1-4) using the same formula.

Note that the randomization is affected also by the elimination of duplication within the groups and then visually assuring that all words are tested. Therefore, the process could be defined as quasi-randomization. In each of the series of randomized processes, duplicates were noted and recalculated (using the Mersenne formula). This intervention again causes the randomization process to be designated as quasi-randomization. A richer example of this process is included in the Addendum (Table i) and should only be viewed for illustration. As noted previously, the researcher was sensitive to the subjectivity in initial screening of possible words to include for testing and determined that this was not a significant impediment to objectivity in the research. Selected words are shown in Table 5 below.

Table 5 (Study 1 and 2):

Study 1 Word Groups

Random Assignment of Words Resulting in Group Assignment
Groups consist of emotion tendency positive/negative

Group 1 Words	Group 2 Words	Group 3 Words	Group 4 Words
trusting	insecure	affectionate	frustrated
surprising	hateful	ecstatic	indifferent
happy	lonely	delighted	disappointed
loving	horrified	joyful	irritating
excited	dejected	enthusiastic	fearful
nervous	hopeful	melancholy	passionate
angry	acceptable	apprehensive	confident
sad	curious	disinterested	friendly
disgusted	cheerful	uneasy	optimistic
anxious	sympathetic	resentful	calm

Study 2 Word Groups

Group #1	Group#2	Group#3	Group#4
nervous	melancholy	affectionate	hopeful
angry	apprehensive	ecstatic	acceptable
sad	disinterested	delighted	curious
disgusted	uneasy	joyful	cheerful
anxious	resentful	enthusiastic	sympathetic
insecure	frustrated	trusting	passionate
hateful	indifferent	surprising	confident
lonely	disappointed	happy	friendly
horrified	irritating	loving	optimistic
dejected	fearful	excited	calm

The complete list of researched words from which these were selected can be found in the Appendix.

Once the word groupings were assembled (10 words within each of the 4 groupings to be administered), the selection of specific triads to be presented and the sample size estimates were interesting problems. In order to quasi-randomize (to assure inclusion of all 40 words in the various subject

presentations and to avoid duplications), the study had to administer 9,880 tests of the 40 words to assure independence. This requirement was met with 130 fully administered surveys, totaling 15,600 triadic comparisons for Study 1 and 139 administered surveys, totaling 16,688 triadic comparisons for Study 2.

- Hierarchical Cluster Analysis.
  This multivariate procedure attempts to identify relatively homogeneous groups of variables (or cases) based on certain characteristics. In the main, HCA is intended to detect natural grouping data by using an assessment algorithm that starts with each variable (or case) in a separate cluster and combines clusters by similarity (or disimilarity) until only one large group is left. The method produces a set of “nested” clusters organized as a hierarchical tree.
- Proximity Matrix.
  Each stage of the cluster analysis combines two variables (cases or groups) into one and a metric is needed to determine that linkage criteria. Based upon the linkage method chosen, this matrix displays the distance or separation between groups.
- Agglomeration Schedule.
  Displays the cases or clusters combined at each stage of the analysis, the distances between groups or clusters being combined (coefficients), and the last cluster level at which a variable joined the cluster. This is the report of the linkage between groups and is also known as amalgamation.
- Dendrogram.
  This is a tree plot of the linkage and proximity matrix algorithm results on the data. It shows the relative similarities of the variables.
- City-block (Manhattan) distance.
  A distance measure computed as the average difference across dimensions. In most cases, this distance measure yields results similar to the simple Euclidean distance (direct “as the crow flies”). However, the effect of single large differences (outliers) is dampened (since they are not squared).

- Ward's Method

  This linkage method uses an analysis of variance approach to evaluate the distances between clusters. For any two hypothetical clusters that can be formed at each step, the procedure minimizes the Sum of Squares so that the pair producing the smallest variance in the merged group are linked.

Procedure for Analysis of Data

Once the data had been consolidated into SPSS, three statistical methods were used to derive and compare results for each word group as an operational check. Since the results for the first two analyses were exploratory, they are not included in this thesis except as an illustration. First a correlation matrix analysis was used (Pearsons) giving a proximity of pairings. Secondly Multi-Dimensional Scaling (Alscal) analysis was performed for two dimensions to depict the relative cohesion. MDS used the Euclidean distance model with stress calculations for each matrix, giving the stimulus coordinates and optimally scaled date (disparities) for the matrix words. This allowed for the similarities and dissimilarities to be revealed on scale. These two statistical methods aided in determining the result reliability of Hierarchical Cluster Analysis, the logical selection of numbers of clusters to view, and determination of the similarity/dissimilarity rules. Finally, Hierarchical Cluster Analysis was used to ascertain the emotion words that group together and to confirm/report cohesion or disparities.

The observed event data (emotion word pairs) for the compiled data from all subjects was treated as the outcome (dependent) variable. The independent variable is the individual words. The hierarchical nature of this study is quite explicit, with the result of *k* clusters in each presentation element (word group) of emotion words. The raw data was measured by count of pairs selected in each presentation element from a display of 10 emotion words in 120 triadic groupings.

The baseline process follows:

1. Outputs (note only the final HCA analysis is included in this paper):
   (a) A print-out of the 10 x 10 Excel matrix was one output – raw data;
   (b) a Proximity Matrix (Correlation) was a second output;
   (c) a cluster diagram figure (MDS-Alscal) was a third output (two dimensions).
   (d) a dendrogram (HCA) printout of the cluster analysis was the final output, reported in this study;

2. The researcher further verified through literature search that emotion words have not been studied using either cluster analysis or the semantic differential in a similar fashion; the first-pass review of the literature indicated that there was limited empirical work (some previously noted) on how emotion words group with each other, and how those clusters reflect specific emotions.

Implications of Research

The purpose of this research was to discover, empirically, how emotion words actually cluster using triadic comparisons and cluster analysis statistics. To reach an understanding of emotions and emotion states, research must include knowledge of the psycholinguistic structure and coherence of emotion states. These analyses are relevant and useful to anyone doing research with emotions. To the extent this analysis is successful, it will tell researchers what words representing Positive and Negative emotions are associated closely together and those that do not. Failing that, the study will indicate what improvements to the research protocol should be made.

Testing the Hypothesis

Triadic comparison and cluster analysis of emotion words for the sample data resulted in quantitative analysis of cohesiveness; so that we may confidently say for this kind of population the results reflect some indicated degree of cluster.

This may be one of the first demonstrations of psycholinguistic coherence of emotion states, at least for the studied population for the chosen emotion words.

Report of Data

The report of findings in this study forms the completion of the Masters Thesis for the University of Louisville, Department of Psychological and Brain Sciences. The thesis includes a complete representation of all procedures, protocols and analysis. The discussion and conclusions will confirm or negate the "proof of concept" hypothesis that, in the studied subjects, emotion words cluster together in an interrelated way, some more closely associated than others with the actual human emotion, and that the clustering conclusions may be representative of a larger population than the sample.

Results

For analysis of all data, distance measurement was carefully explored (Chebychev, Euclidean, Squared Euclidean, City-block), as was the amalgamation or linkage rules (Single, Complete, Ward's) before deciding the preferred method. The choice of Wards linkage (essentially sum of squares) and City-Block (known as Manhattan distance) was made after considerable review and testing to ascertain the most appropriate number of cluster groups (nodes) and the clarity of the clusters. All groups were subjected to the same analysis settings and each included a cluster range of a minimum of 3 and a maximum of 6. Note that the complete analysis output is found in the Appendix for review.

Study 1:

In Study 1, using the mixture of positive and negative words, the following analysis by Group revealed interesting correlations and some surprising results. Note that the complete process of evaluation is contained in Group 1-1, then simplified results are shown in all other Groups for the convenience of the reader. The analysis concludes in an overall Primary, Secondary and Tertiary Coherence table for each Study.

Group 1-1

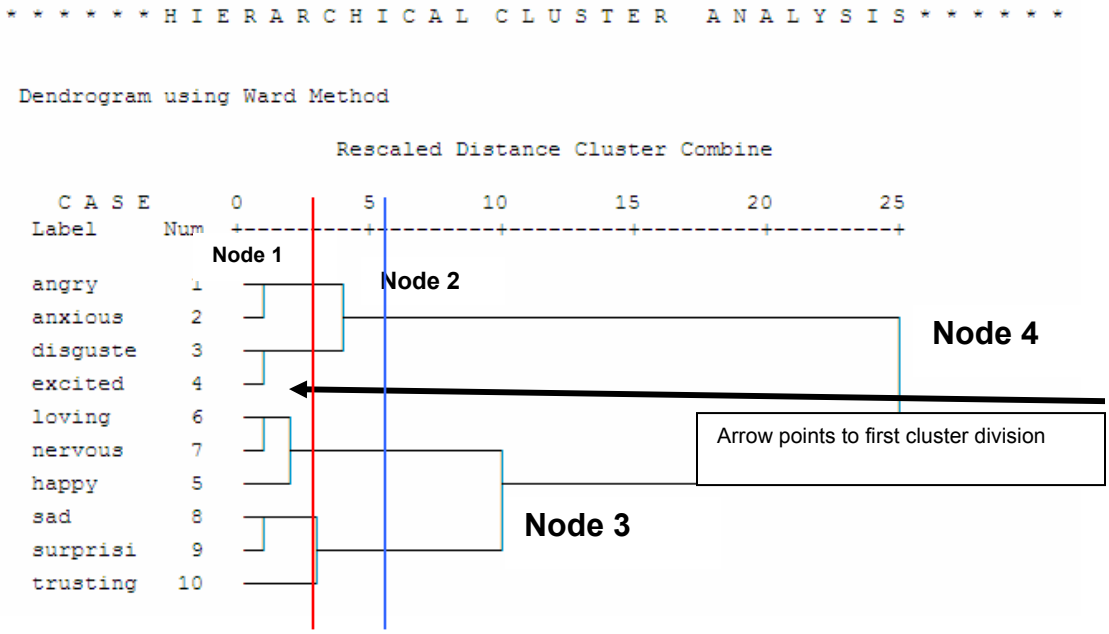
The agglomeration schedule for group 1 indicated by the jump in coefficients (a 76% change from stage 5 to stage 6) the appropriate number of clusters to be 5 and therefore the range of solutions selected was a minimum of 3 and a maximum of 6. The resulting cluster dendrogram shows cohesion in two main (upper/lower) cluster structures, with the division (no linkage) situated between the words *excited* and *loving*. Further, the lower nested cluster is divided similarly between *happy* and *sad*.

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	2	51.500	0	0	7
2	3	4	109.000	0	0	7
3	6	7	172.000	0	0	5
4	8	9	245.500	0	0	6
5	5	6	337.167	0	3	8
6	8	10	457.000	4	0	8
7	1	3	596.500	1	2	9
8	5	8	899.500	5	6	9
9	1	5	1625.400	7	8	0

Proximity Matrix

Case	Matrix File Input									
	Angry	anxious	disgusted	excited	happy	loving	nervous	sad	surprising	trusting
angry	.000	103.000	171.000	286.000	348.000	464.000	548.000	604.000	711.000	845.000
anxious	103.000	.000	130.000	189.000	311.000	369.000	493.000	527.000	622.000	750.000
disgusted	171.000	130.000	.000	115.000	195.000	317.000	387.000	473.000	578.000	692.000
excited	286.000	189.000	115.000	.000	140.000	208.000	318.000	382.000	489.000	583.000
happy	348.000	311.000	195.000	140.000	.000	138.000	200.000	310.000	423.000	503.000
loving	464.000	369.000	317.000	208.000	138.000	.000	126.000	198.000	305.000	409.000
nervous	548.000	493.000	387.000	318.000	200.000	126.000	.000	142.000	239.000	333.000
sad	604.000	527.000	473.000	382.000	310.000	198.000	142.000	.000	147.000	265.000
surprising	711.000	622.000	578.000	489.000	423.000	305.000	239.000	147.000	.000	168.000
trusting	845.000	750.000	692.000	583.000	503.000	409.000	333.000	265.000	168.000	.000

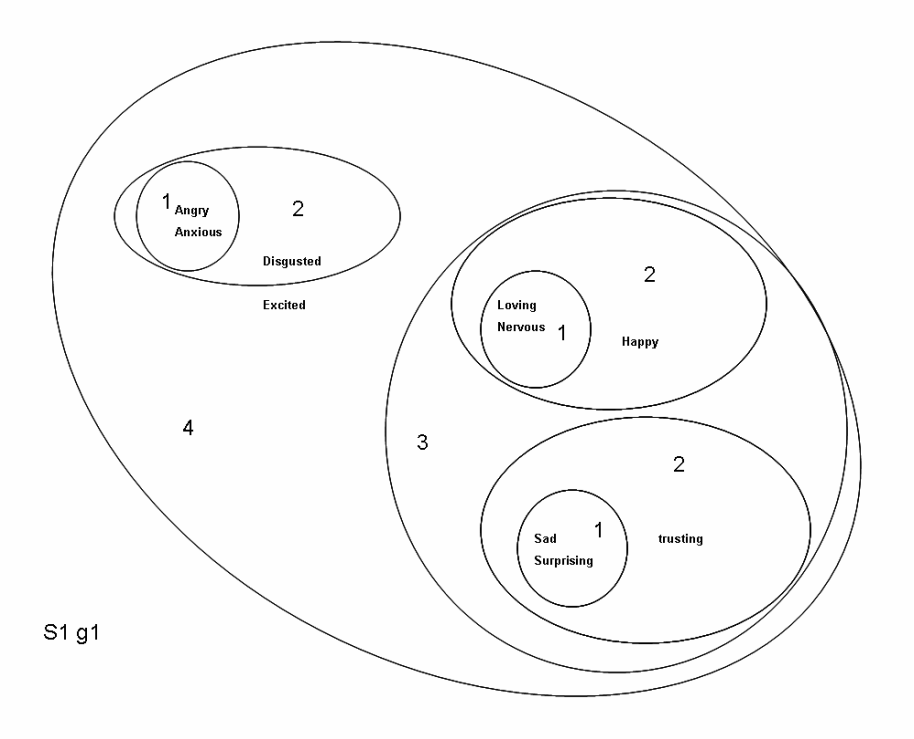


Additionally, the red line drawn at about the rescaled distance of 3, confirms a 5 cluster solution to analyzing the data; the blue line drawn suggests a three cluster analysis. Since most of the pairings occur left of the red line, a five cluster solution would be appropriate and distances computed would be small suggesting similarity.

Group 1-1 Observations:

A first supposition, considering the mix of words, would be that a clear distinction between positive/negative should appear. This proves not to be strictly the case.

Perhaps a different view will facilitate clarity (refer to the Proximity Matrix for distance, discussed below).



In the above rendering of the dendrogram and proximity measures, it is easy to discover those emotion words that cluster together. Additionally, the illustration shows which emotion words or clusters do not link or have considerable distance from each other:

- Angry/Anxious closely paired
- Loving/Nervous closely paired
- Sad/Surprising closely paired
- Angry-Anxious/Disgusted linked at greater distance
- Loving-Nervous/Happy linked at greater distance
- Sad-Surprising/Trusting linked at greater distance

What is unusual is which words join at the most similar stage. While *angry/anxious/disgusted* may express similar emotions, other combinations are more suspect; for instance, *sad/surprising* or *loving/nervous*. Notice that in the lower cluster, *loving/nervous* are joined in early stages, as are *sad/surprising.* In

considering these two clusters, one must question the inclusion of *nervous* with *loving*, as well as *sad* with *surprising*. How do these emotions relate? Is this pairing an intentional, deliberate selection, or was the forced choice methodology of the triadic comparison the cause of this combination?
A more detailed analysis follows:

Node 1. Sub-clusters (nested) contain those most closely cohering (Paired Proximity measurement in [ ] and rescaled distance viewed in dendrogram):

Upper

- *Angry/Anxious [103] joined at a rescaled distance of approximately 2*
- *Disgusted/excited [115] joined at same distance as above*

Lower

- *Loving/nervous [126] joined at similar distance as above*
- *Sad/surprising [147] joined at similar distance as above*

Node 2. While this nested cluster joins three emotion words in the upper cluster, *angry/anxious/disgusted*, *excited* is not included and could be considered an outlier. Viewing the Proximity Matrix, the distance difference among the first three is significantly smaller (thus similarity greater) than the distance from *excited* to any of the three.

The same is not true for *sad/surprising/trusting* where trusting is combined. *Trusting* is closer to *surprising [168]* than *sad [265]* represented in the Proximity Matrix. At this stage *loving/nervous/happy* are joined also. Although the dendrogram does not clearly denote, *loving* is closer to *nervous* [126] than to *happy [200],* an unexpected occurrence. Note that at this stage there is also no linkage between the clusters *loving/nervous/happy* and s*ad/surprising/trusting.*

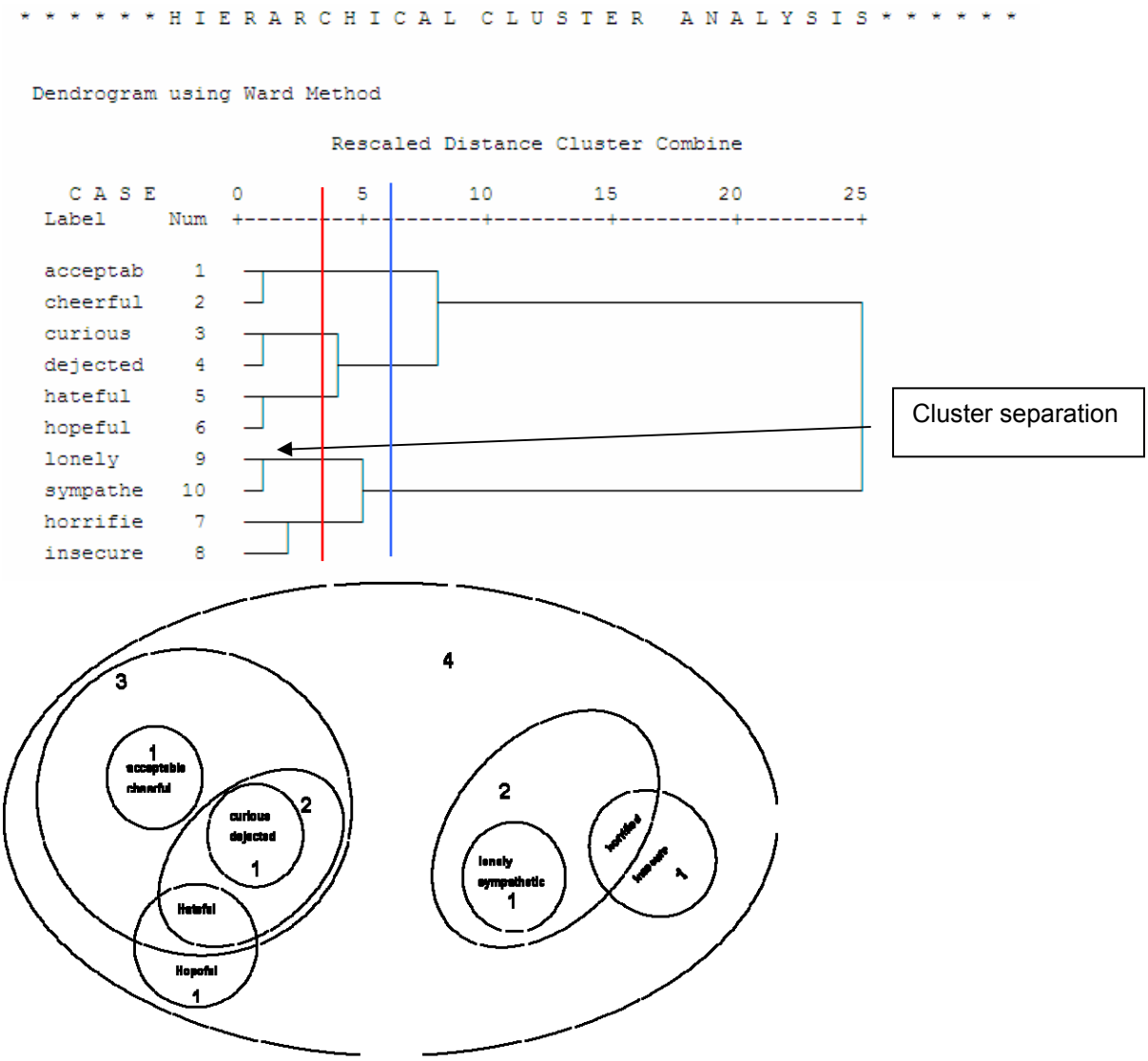
Group 1-2

This group showed separation into two main clusters between *hopeful* and *lonely*. Similar to Group 1-1, the division would have been expected between

positive and negative words. Although somewhat aligned with that concept, the placement of *hateful* and *dejected* in the top cluster was surprising. Even more unexpected was the joining of *curious/dejected* and *hateful/hopeful* in the first node.

Proximity Matrix

Case	Matrix File Input									
	acceptable	cheerful	curious	dejected	hateful	hopeful	horrified	insecure	lonely	sympathetic
acceptable	.000	71.000	168.000	262.000	338.000	397.000	502.000	575.000	665.000	742.000
cheerful	71.000	.000	97.000	191.000	267.000	326.000	431.000	504.000	594.000	671.000
curious	168.000	97.000	.000	104.000	170.000	247.000	352.000	429.000	507.000	594.000
dejected	262.000	191.000	104.000	.000	118.000	165.000	298.000	345.000	453.000	540.000
hateful	338.000	267.000	170.000	118.000	.000	119.000	216.000	277.000	377.000	464.000
hopeful	397.000	326.000	247.000	165.000	119.000	.000	141.000	208.000	294.000	381.000
horrified	502.000	431.000	352.000	298.000	216.000	141.000	.000	173.000	197.000	280.000
insecure	575.000	504.000	429.000	345.000	277.000	208.000	173.000	.000	134.000	221.000
lonely	665.000	594.000	507.000	453.000	377.000	294.000	197.000	134.000	.000	99.000
sympathetic	742.000	671.000	594.000	540.000	464.000	381.000	280.000	221.000	99.000	.000



S1 g2

The rendering and the dendrogram show the relative clustering in this group. While some clusters (acceptable/cheerful, lonely/sympathetic) could be expected, anomalies are sufficient to encourage additional analysis. What is the emotional connection between *hateful/hopeful*, *curious* and *dejected* or *horrified* and *insecure* for example?

Group 1-3

Word group 3 also shows unexpected clusters. In Node 1:

affectionate/apprehensive, disinterested/ecstatic, joyful/melancholy were not expected, while the cluster *resentful/uneasy* is more easily understood.

Proximity Matrix

Case	Matrix File Input									
	affectionate	apprehensive	delighted	Disinterested	ecstatic	enthusiastic	joyful	melancholy	resentful	uneasy
affectionate	.000	97.000	211.000	264.000	385.000	477.000	610.000	651.000	744.000	881.000
apprehensive	97.000	.000	114.000	193.000	288.000	390.000	513.000	554.000	647.000	802.000
delighted	211.000	114.000	.000	131.000	222.000	328.000	435.000	500.000	583.000	706.000
disinterested	264.000	193.000	131.000	.000	121.000	217.000	348.000	397.000	480.000	617.000
ecstatic	385.000	288.000	222.000	121.000	.000	136.000	243.000	304.000	365.000	526.000
enthusiastic	477.000	390.000	328.000	217.000	136.000	.000	165.000	218.000	319.000	454.000
joyful	610.000	513.000	435.000	348.000	243.000	165.000	.000	143.000	250.000	361.000
melancholy	651.000	554.000	500.000	397.000	304.000	218.000	143.000	.000	153.000	290.000
resentful	744.000	647.000	583.000	480.000	365.000	319.000	250.000	153.000	.000	173.000
uneasy	881.000	802.000	706.000	617.000	526.000	454.000	361.000	290.000	173.000	.000

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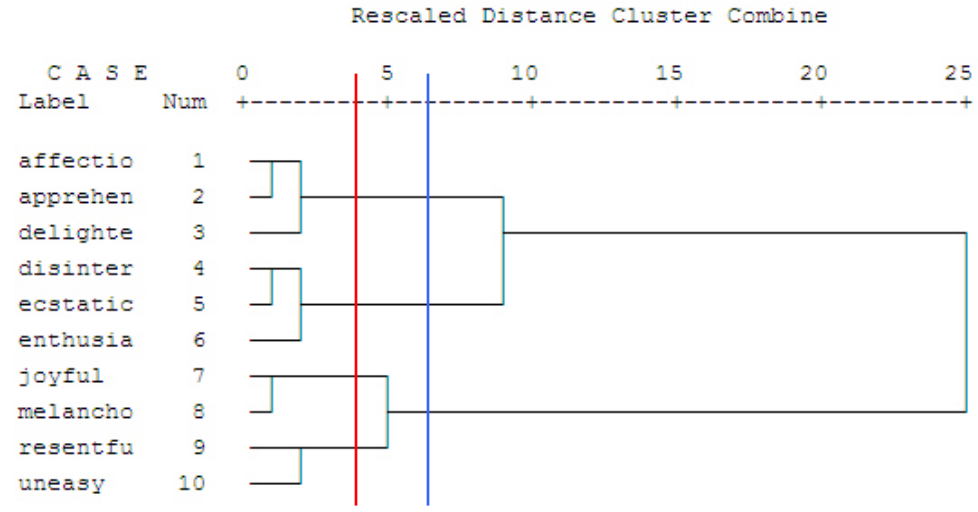
Dendrogram using Ward Method

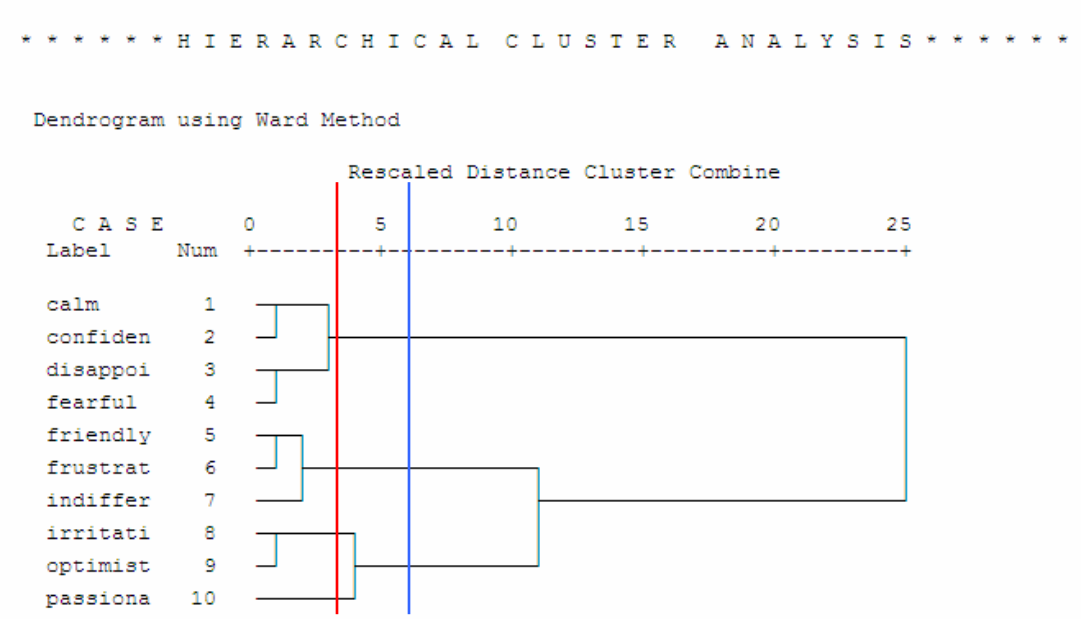


Group 1-4

Word group 4 analysis again splits the word group into two main clusters, viewed right to left.

Proximity Matrix

Case	Matrix File Input									
	calm	confident	disappointed	fearful	friendly	frustrated	indifferent	irritating	optimistic	passionate
calm	.000	93.000	160.000	216.000	336.000	410.000	475.000	553.000	642.000	715.000
confident	93.000	.000	101.000	139.000	259.000	341.000	400.000	500.000	601.000	652.000
disappointed	160.000	101.000	.000	102.000	194.000	276.000	319.000	411.000	500.000	555.000
fearful	216.000	139.000	102.000	.000	120.000	202.000	261.000	361.000	462.000	521.000
friendly	336.000	259.000	194.000	120.000	.000	110.000	159.000	295.000	390.000	443.000
frustrated	410.000	341.000	276.000	202.000	110.000	.000	119.000	203.000	302.000	389.000
indifferent	475.000	400.000	319.000	261.000	159.000	119.000	.000	144.000	237.000	290.000
irritating	553.000	500.000	411.000	361.000	295.000	203.000	144.000	.000	125.000	240.000
optimistic	642.000	601.000	500.000	462.000	390.000	302.000	237.000	125.000	.000	191.000
passionate	715.000	652.000	555.000	521.000	443.000	389.000	290.000	240.000	191.000	.000



Clusters formed at Node 1 are (from the base of the tree):

Calm/confident

Disappointed/fearful

Friendly/frustrated

Irritating/optimistic

Again, conclusively explaining expected versus calculated association is difficult. Significant clustering at rescaled distance of 5 or less (fairly close approximation) reveals:

Calm/confident/disappointed

Friendly/frustrated/indifferent

Irritating/optimistic/passionate

Study 1 Conclusions

Analysis confirms the cohesion of emotion words, albeit some unexpected clustering. (See following table.)

Study 1 Coherent Clusters include:

Primary Cluster (spacing represents cluster branch separation)	**Secondary Cluster Combine (rescaled distance of 5 or less)**	**Tertiary Cluster Combine –Significant only (rescaled distance of 5-10)**
Angry/anxious Disgusted/excited	Angry/anxious/disgusted	
Loving/nervous Sad/surprising	Loving/nervous/happy Sad/surprising/trusting	Loving/nervous/happy/sad/surprising/trusting
Acceptable/cheerful Curious/dejected Hateful/hopeful	Curious/dejected/hateful	Acceptable/cheerful/curious/dejected/hateful
Lonely sympathetic Horrified/insecure	Lonely/sympathetic/horrified	
Affectionate/apprehensive	Affectionate/apprehensive/delighted	Affectionate/apprehensive/delighted/disinterested/ ecstatic/enthusiastic
Disinterested/ecstatic	Disinterested/ecstatic/enthusiastic	
Joyful/melancholy Resentful/uneasy	Joyful/melancholy/resentful	
Calm/confident Disappointed/fearful	Calm/confident/disappointed	
Friendly/frustrated Irritating/optimistic	Friendly/frustrated/indifferent Irritating/optimistic/passionate	Friendly/frustrated/indifferent/irritating/ optimistic/passionate

What can be concluded from this HCA is that, although some clusters contain words reasonably expected to cohere, there are enough anomalies to question the overall methodology of randomly mixing positive and negative emotion words in a triadic comparison of the type administered. Most unusual was the lack of

distinction between assumed positive and negative emotion descriptors. This conclusion in the initial study (study 1) suggested an additional survey (study 2) should be administered.

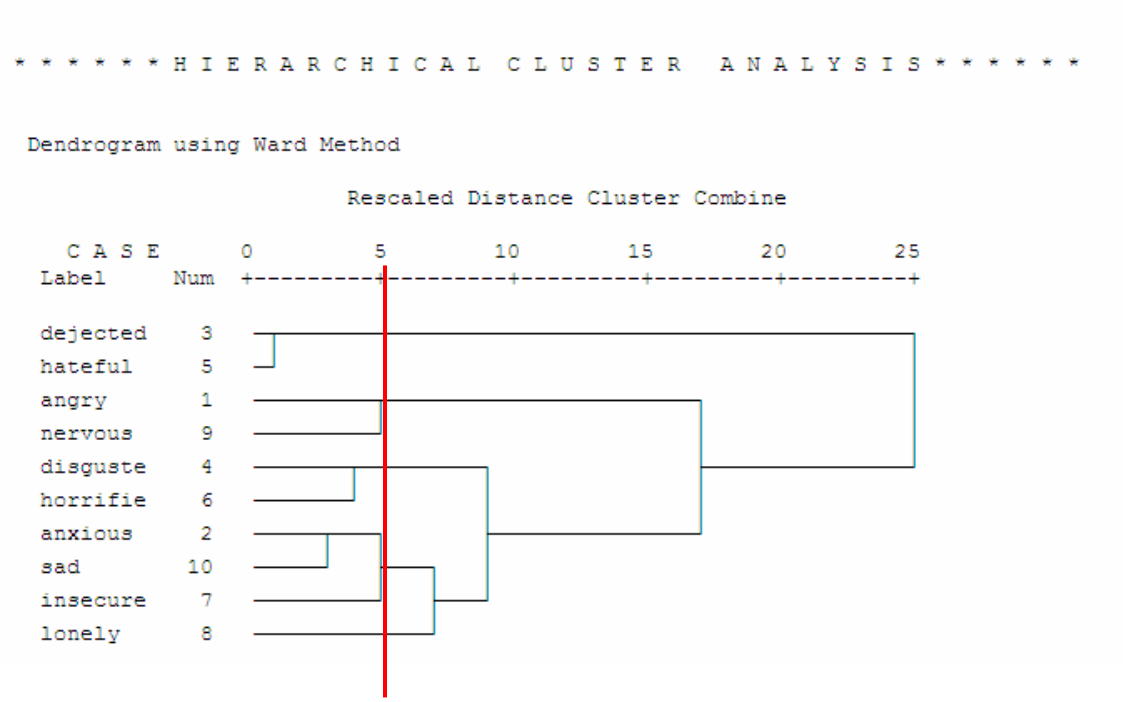
Study 2

The second survey (study 2) was conducted with the significant interest of discovering linkage between emotion words of similar ilk (e.g. positive/positive) as well as determining the efficacy of the triadic comparison methodology. Following the same analytical path and settings as in Study 1, Study 2 consists of 4 Groups of the same words presented in the first Study, except that the words were placed into groups of like emotions (positive or negative). Following the HCA statistics, given with limited commentary, is the Conclusion Table for Study 2.

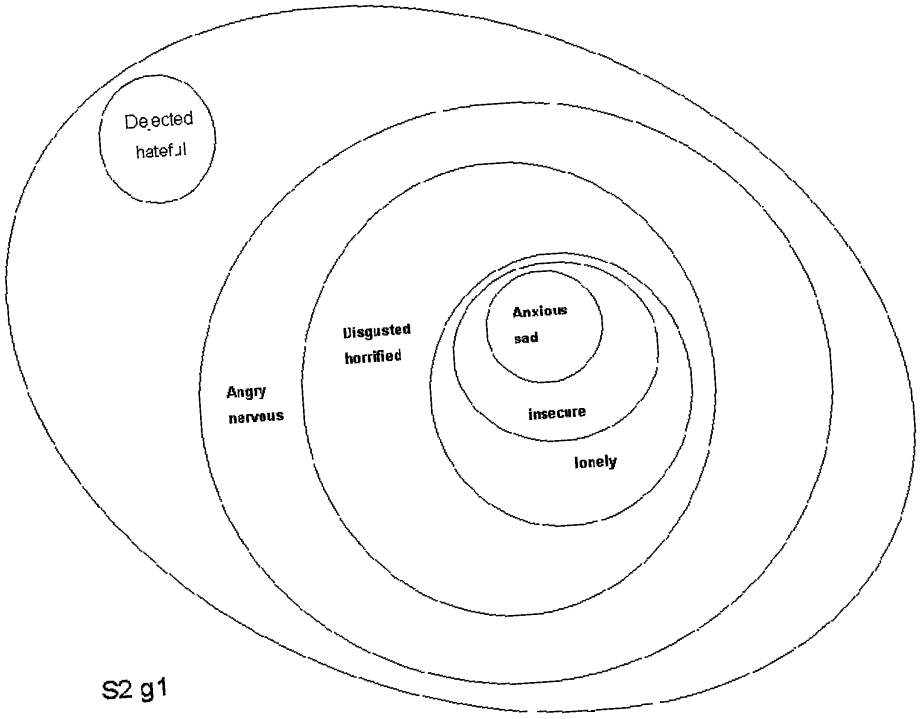
Word Group 2-1

Proximity Matrix

Case	Matrix File Input									
	angry	anxious	dejected	disgusted	hateful	horrified	insecure	lonely	nervous	sad
angry	.000	350.000	350.000	308.000	375.000	402.000	307.000	344.000	274.000	346.000
anxious	350.000	.000	346.000	250.000	359.000	288.000	267.000	266.000	312.000	248.000
dejected	350.000	346.000	.000	384.000	219.000	432.000	317.000	352.000	322.000	364.000
disgusted	308.000	250.000	384.000	.000	395.000	266.000	275.000	316.000	310.000	276.000
hateful	375.000	359.000	219.000	395.000	.000	399.000	318.000	363.000	373.000	333.000
horrified	402.000	288.000	432.000	266.000	399.000	.000	343.000	282.000	396.000	320.000
insecure	307.000	267.000	317.000	275.000	318.000	343.000	.000	309.000	301.000	281.000
lonely	344.000	266.000	352.000	316.000	363.000	282.000	309.000	.000	298.000	296.000
nervous	274.000	312.000	322.000	310.000	373.000	396.000	301.000	298.000	.000	328.000
sad	346.000	248.000	364.000	276.000	333.000	320.000	281.000	296.000	328.000	.000



The red line drawn at the rescaled distance of 5, indicates that a five cluster solution is appropriate. Again, for methodological clarity, the following rendering of the dendrogram reveals the relative cohesion or clustering.



Interestingly, this analysis clusters the majority of emotion words into a single branch. The cluster *dejected/hateful* is separated from all others in this group. Note that *angry* is significantly far from *sad* or *insecure* for example, and could indicate emotional intensity or expressiveness components of the clustering. As an example, the intensity (or expressiveness) related to the emotion *anger* is often more outwardly obvious than, say *insecurity* or *loneliness*.

Group 2-2

Proximity Matrix

Case	Matrix File Input									
	apprehensive	disappointed	disinterested	fearful	frustrated	indifferent	irritating	melancholy	resentful	uneasy
apprehensive	.000	83.000	179.000	250.000	294.000	380.000	465.000	528.000	697.000	724.000
disappointed	83.000	.000	96.000	167.000	241.000	321.000	382.000	471.000	614.000	641.000
disinterested	179.000	96.000	.000	131.000	205.000	279.000	338.000	407.000	536.000	597.000
fearful	250.000	167.000	131.000	.000	134.000	204.000	299.000	376.000	467.000	552.000
frustrated	294.000	241.000	205.000	134.000	.000	130.000	201.000	254.000	411.000	452.000
indifferent	380.000	321.000	279.000	204.000	130.000	.000	151.000	198.000	399.000	446.000
irritating	465.000	382.000	338.000	299.000	201.000	151.000	.000	107.000	308.000	309.000
melancholy	528.000	471.000	407.000	376.000	254.000	198.000	107.000	.000	235.000	276.000
resentful	697.000	614.000	536.000	467.000	411.000	399.000	308.000	235.000	.000	147.000
uneasy	724.000	641.000	597.000	552.000	452.000	446.000	309.000	276.000	147.000	.000

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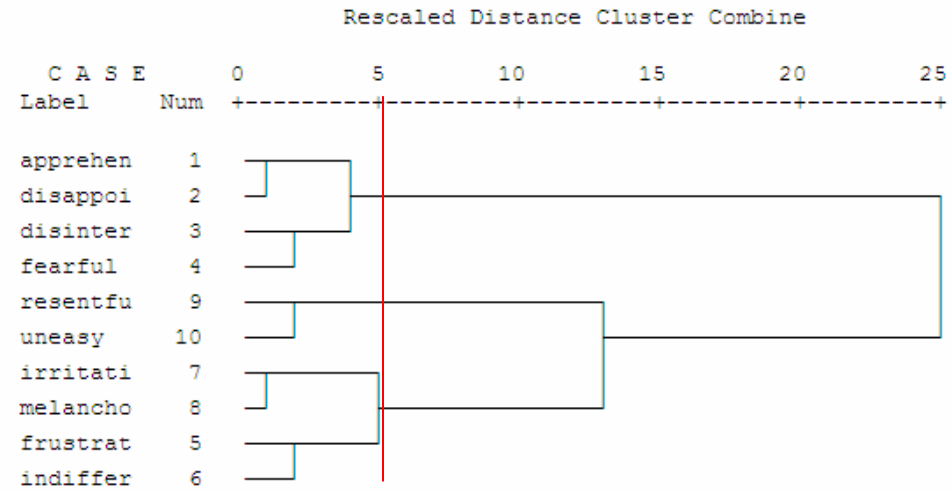
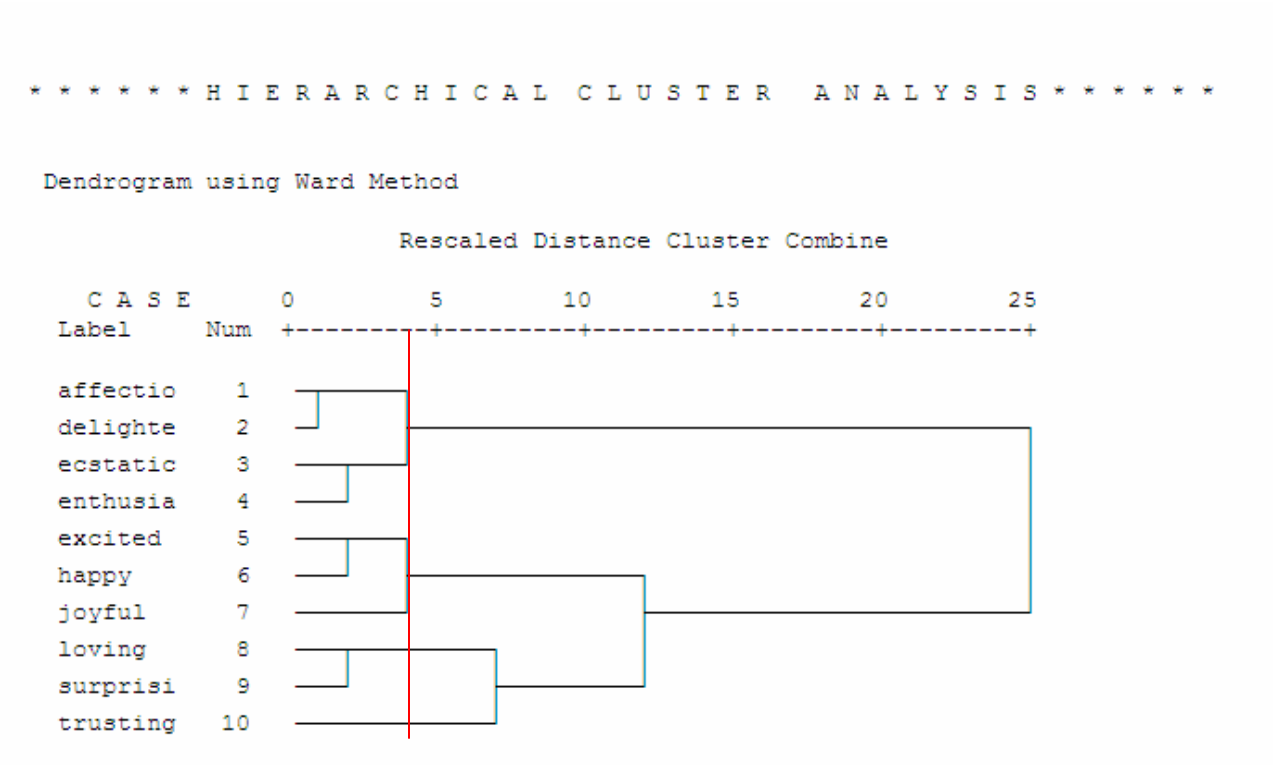
Dendrogram using Ward Method



Group 2-3

Proximity Matrix

Case	Matrix File Input									
	affectionate	delighted	ecstatic	enthusiastic	excited	happy	joyful	loving	surprising	trusting
affectionate	.000	106.000	226.000	259.000	427.000	559.000	533.000	746.000	806.000	778.000
delighted	106.000	.000	120.000	245.000	321.000	453.000	467.000	640.000	700.000	748.000
ecstatic	226.000	120.000	.000	175.000	309.000	333.000	407.000	554.000	580.000	640.000
enthusiastic	259.000	245.000	175.000	.000	238.000	300.000	284.000	487.000	547.000	519.000
excited	427.000	321.000	309.000	238.000	.000	180.000	280.000	479.000	553.000	533.000
happy	559.000	453.000	333.000	300.000	180.000	.000	206.000	359.000	405.000	435.000
joyful	533.000	467.000	407.000	284.000	280.000	206.000	.000	265.000	331.000	415.000
loving	746.000	640.000	554.000	487.000	479.000	359.000	265.000	.000	204.000	492.000
surprising	806.000	700.000	580.000	547.000	553.000	405.000	331.000	204.000	.000	314.000
trusting	778.000	748.000	640.000	519.000	533.000	435.000	415.000	492.000	314.000	.000



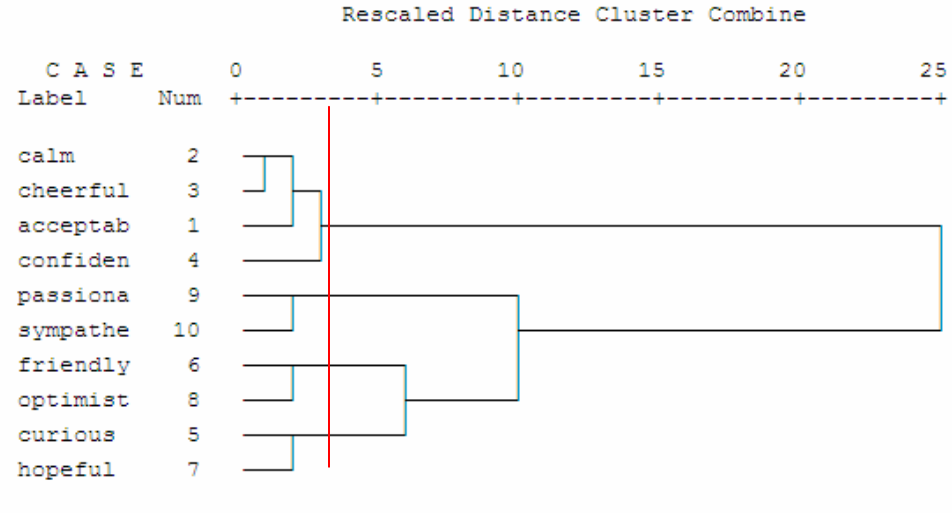
Group 2-4

Proximity Matrix

Case	Matrix File Input									
	acceptable	calm	cheerful	confident	curious	friendly	hopeful	optimistic	passionate	sympathetic
acceptable	.000	94.000	184.000	299.000	517.000	565.000	601.000	639.000	762.000	835.000
calm	94.000	.000	90.000	205.000	423.000	471.000	507.000	551.000	762.000	785.000
cheerful	184.000	90.000	.000	115.000	333.000	381.000	417.000	469.000	680.000	731.000
confident	299.000	205.000	115.000	.000	218.000	294.000	340.000	448.000	609.000	662.000
curious	517.000	423.000	333.000	218.000	.000	316.000	196.000	290.000	459.000	532.000
friendly	565.000	471.000	381.000	294.000	316.000	.000	306.000	166.000	363.000	438.000
hopeful	601.000	507.000	417.000	340.000	196.000	306.000	.000	270.000	363.000	446.000
optimistic	639.000	551.000	469.000	448.000	290.000	166.000	270.000	.000	255.000	330.000
passionate	762.000	762.000	680.000	609.000	459.000	363.000	363.000	255.000	.000	185.000
sympathetic	835.000	785.000	731.000	662.000	532.000	438.000	446.000	330.000	185.000	.000

* * * * * * H I E R A R C H I C A L C L U S T E R A N A L Y S I S * * * * * *

Dendrogram using Ward Method



Study 2 Conclusions

Study 2 Coherent Clusters include:

Primary Clusters Combine (spacing represents cluster branch separation)	**Secondary Clusters Combine (rescaled distance of 5 or less)**	**Tertiary Cluster Combine Significant only (rescaled distance of 5-10)**
Dejected/hateful Angry/nervous Disgusted/horrified Anxious/sad	 Anxious/sad/insecure (note: lonely/anxious/sad/insecure combine at approx. distance 8)	 Disgusted/horrified/anxious/sad/ Insecure/lonely
Apprehensive/disappointed Disinterested/fearful Irritating/melancholy Resentful/uneasy Frustrated/indifferent	Apprehensive/disappointed/disinterested Irritating/melancholy/frustrated	
Affectionate/delighted Ecstatic/enthusiastic Excited/happy Loving/surprising	Affectionate/delighted/ecstatic Excited/happy/joyful	 Loving/surprising/trusting
Calm/cheerful Passionate/sympathetic Friendly/optimistic Curious/hopeful	Calm/cheerful/acceptable Calm/cheerful/acceptable/confident Friendly/optimistic/curious	 Passionate/sympathetic/friendly/ optimistic/curious

Discussion

The research design initially was to test 40 emotion words for cohesiveness, however, in the final form the researcher essentially created 4 independent tests of emotion words in Study 1. Since the randomization of positive/negative words, in effect, constructed groups within which some forced selection choices were not representative to the subjects, results were sometimes surprising. After the initial survey findings, it was ascertained a second Study was necessary to derive more conclusive representations of the cohesion of these emotion words (Study 2). Again, the design essentially created 4 independent tests of emotion words; this time each group contained only Positive or Negative words.

Study 2 provided more understandable clustering of words, divided by positive or negative emotional tendency. While some clusters were anomalous, which could be explained by the forced choice methodology, the clusters were considerably more coherent. Therefore, the utility of triadic comparison and Hierarchical Cluster Analysis as protocols seems to be a valid procedure.

Considering previously noted studies, Plutchik's observation that the subjectivity of arousal level is problematic to research, additional study of the intensity of emotions can benefit from understanding psycholinguistic coherence. Indeed, while the debate of neurophysiologic emotional processes at work continues, having a model to classify emotions according to their similarities becomes increasingly useful. Tomkins, Damasio and others appear correct in judging that emotions influence human behavior, and that primary or derived emotions involve complex systems and processes in evaluating both current and remembered experience. Whether humans have an innate or acquired capacity for coloring cognition and behavioral responses through the lens of emotion, language provides a window for understanding emotional states.

Recommendations

While exit interviews were not included in this research, some voluntary comments were received and noted. Generally, the comments revealed that the survey was tedious because of the requirement to include all possible triadic comparisons of the 10 words presented. This may have resulted in forced choices having little or no relationship apparent to the subject in actuality. Indeed, the repetition of randomly presenting the 120 triads of the 10 words within each group may have skewed results. Future research initiatives may also benefit in allowing subjects to “free form” comments after concluding the survey.

Various sample size and randomization techniques may require further examination. One method of solving these issues could have been to conduct the survey including a random selection from the selected 40 words (or, in fact, the 153 available) to a specific, small number of subjects initially, weighting the results after a preliminary cluster analysis. The weighting could reduce the number of words and combinations available for the next group of subjects. This is not a sufficient solution due to the inherent bias that could result and interference with independence of the tests.

Another method might have been to administer tests to a specific number of subjects that selected from all 40 words, as in the Excel sheet in the Addendum. As the clusters were revealed, one could test those words with the same or other subjects, ignoring those words that were not tested or removing them from the lists. Also not a good solution.

Still another method would construct a survey of all 40 words to administer to each subject. That would result in each subject sitting through a presentation of 9,880 triads. An impossible task.

An appropriate observation, post hoc, is that a more effective methodology would be to conduct both studies of this research on the same subjects. This would allow for more definitive conclusions about the coherence of the chosen emotion words and additional statistical analysis could be performed. Further, perhaps choosing to “prime” the subject with a “core” emotion word, allowing that subject to choose from dyads those words that most closely cohere to that basic emotion would prove beneficial.

Finally, with regard to the subjective choice of emotion words to study, care should be given. In order to ascertain true cohesion, emotional intensity must be a factor. For future studies, particularly imaging analysis of neural correlates of emotions, accepting the universal linguistic hierarchy common to the studied population should be taken into consideration. Knowing how closely these emotion words cluster together will facilitate a clearer understanding of the actual processes at work in the ongoing mystery of the human mind.

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Appendix

Emotion Words, Previous Research:

Originally Compiled by Ortony and Turner (Ortony, A., Turner, T. Psychological Review,1990, vol.97, No. 3, 315-331):

Theorist	Basic Emotions	Basis for Inclusion
Plutchik (1980)	Acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise	Relation to adaptive biological processes
Arnold (1960)	Anger, aversion, courage, dejection, desire, despair, fear, hate, hope, love, sadness	Relation to action tendencies
Ekman, Friesen, and Ellsworth (1982)	Anger, disgust, fear, joy, sadness, surprise	Universal facial expressions
Frijda (1986)	Desire, happiness, interest, surprise, wonder, sorrow	Forms of action readiness
Gray (1982)	Rage and terror, anxiety, joy	Hardwired
Izard (1971)	Anger, contempt, disgust, distress, fear, guilt, interest, joy, shame, surprise	Hardwired
James (1884)	Fear, grief, love, rage	Bodily involvement
McDougall (1926)	Anger, disgust, elation, fear, subjection, tender-emotion, wonder	Relation to instincts
Mowrer (1960)	Pain, pleasure	Unlearned emotional states
Oatley and Johnson-Laird (1987)	Anger, disgust, anxiety, happiness, sadness	Do not require propositional content
Panksepp (1982)	Expectancy, fear, rage, panic	Hardwired
Tomkins (1984)	Anger, interest, contempt, disgust, distress, fear, joy, shame, surprise	Density of neural firing
Watson (1930)	Fear, love, rage	Hardwired
Weiner and Graham (1984)	Happiness, sadness	Attribution independent

As described in Parrot (2001):

Primary emotion	Secondary emotion	Tertiary emotions
Love	Affection	Adoration, affection, love, fondness, liking, attraction, caring, tenderness, compassion, sentimentality
	Lust	Arousal, desire, lust, passion, infatuation
	Longing	Longing
Joy	Cheerfulness	Amusement, bliss, cheerfulness, gaiety, glee, jolliness, joviality, joy, delight, enjoyment, gladness, happiness, jubilation, elation, satisfaction, ecstasy, euphoria
	Zest	Enthusiasm, zeal, zest, excitement, thrill, exhilaration
	Contentment	Contentment, pleasure
	Pride	Pride, triumph
	Optimism	Eagerness, hope, optimism
	Enthrallment	Enthrallment, rapture
	Relief	Relief
Surprise	Surprise	Amazement, surprise, astonishment
Anger (cont. below)	Irritation	Aggravation, irritation, agitation, annoyance, grouchiness, grumpiness
	Exasperation	Exasperation, frustration
	Rage	Anger, rage, outrage, fury, wrath, hostility, ferocity, bitterness, hate, loathing, scorn, spite, vengefulness, dislike, resentment
	Disgust	Disgust, revulsion, contempt
	Envy	Envy, jealousy
	Torment	Torment

Sadness	Suffering	Agony, suffering, hurt, anguish
	Sadness	Depression, despair, hopelessness, gloom, glumness, sadness, unhappiness, grief, sorrow, woe, misery, melancholy
	Disappointment	Dismay, disappointment, displeasure
	Shame	Guilt, shame, regret, remorse
	Neglect	Alienation, isolation, neglect, loneliness, rejection, homesickness, defeat, dejection, insecurity, embarrassment, humiliation, insult
	Sympathy	Pity, sympathy
Fear	Horror	Alarm, shock, fear, fright, horror, terror, panic, hysteria, mortification
	Nervousness	Anxiety, nervousness, tenseness, uneasiness, apprehension, worry, distress, dread

The following pages depict the emotion words selected for study, and a representation of the randomization calculations (positive/neutral words in yellow, negative in green for Study 1, reversed in Study 2). Following these is the list of words found in research to have been studied previously (forming the selection universe for this study).

Study 1

Group 1 Words	Group 2 Words	Group 3 Words	Group 4 Words
trusting	insecure	affectionate	frustrated
surprising	hateful	ecstatic	indifferent
happy	lonely	delighted	disappointed
loving	horrified	joyful	irritating
excited	dejected	enthusiastic	fearful
nervous	hopeful	melancholy	passionate
angry	acceptable	apprehensive	confident
sad	curious	disinterested	friendly
disgusted	cheerful	uneasy	optimistic
anxious	sympathetic	resentful	calm

Study 2

Group #1	Group#2	Group#3	Group#4
nervous	melancholy	affectionate	hopeful
angry	apprehensive	ecstatic	acceptable
sad	disinterested	delighted	curious
disgusted	uneasy	joyful	cheerful
anxious	resentful	enthusiastic	sympathetic
insecure	frustrated	trusting	passionate
hateful	indifferent	surprising	confident
lonely	disappointed	happy	friendly
horrified	irritating	loving	optimistic
dejected	fearful	excited	calm

Randomization Algorithm

Mersenne Twister(MT) is a pseudo-random number generating algorithm developed by Makoto Matsumoto and Takuji Nishimura in 1996-1997. An improvement on initialization was given in 2002. MT is designed according to the modern researches on the practical conditions which a generator should satisfy.

There is no rigorous mathematical assurance for MT to be a defect-free random number generator.

However, it is widely believed that the spectral test is one of the strongest tests to select a good generator. MT is designed to pass a similar test, called the k-distribution test. MT passed many stringent tests, including the diehard test by G.Marsaglia and the load test by P.Hellekalek and S.Wegenkittl.

This algorithm has the following merits:

- It is designed with consideration on the flaws of various existing generators.
- The algorithm is coded into a C-source and available as an add-on to Microsoft Excel.
- Far longer period and far higher order of equi-distribution than any other implemented generators.
- Fast generation. (Although it depends on the system, it is reported that MT is sometimes faster than the standard ANSI-C library in a system with pipeline and cache memory.)
- Efficient use of the memory.

Researched Words

Original Word #	Word	Random Assigned # (sorted in ascending order)	Group Assignment Random
8	passionate	1	4
9	trusting	2	1
17	surprising	3	1
1	affectionate	4	3
19	ecstatic	5	3
3	confident	6	4
20	hopeful	7	2
2	delighted	8	3
6	joyful	9	3
5	friendly	10	4
10	optimistic	11	4
15	calm	12	4
4	happy	13	1
7	loving	14	1
12	acceptable	15	2
14	curious	16	2
11	excited	17	1
16	cheerful	18	2
18	sympathetic	19	2
13	enthusiastic	20	3
21	angry	21	1
22	disgusted	29	1
25	sad	24	1
24	anxious	27	1
23	nervous	30	1
30	insecure	25	2
29	hateful	26	2
27	lonely	28	2
26	horrified	31	2
28	dejected	37	2
36	melancholy	22	3
31	apprehensive	23	3
33	disinterested	29	3
35	uneasy	32	3
34	resentful	34	3
39	frustrated	33	4
32	indifferent	35	4
37	disappointed	36	4
40	irritating	38	4
38	fearful	40	4

(Note: Randomization utilizing Mersenne Twister Algorithm)

Random Assignment of Words Resulting in Group Assignment

Groups consist of emotion tendency positive/negative

Group 1 Words	Group 2 Words	Group 3 Words	Group 4 Words
trusting	insecure	affectionate	frustrated
surprising	hateful	ecstatic	indifferent
happy	lonely	delighted	disappointed
loving	horrified	joyful	irritating
excited	dejected	enthusiastic	fearful
nervous	hopeful	melancholy	passionate
angry	acceptable	apprehensive	confident
sad	curious	disinterested	friendly
disgusted	cheerful	uneasy	optimistic
anxious	sympathetic	resentful	calm

By assigning the group of words in order of subject log on, in sequence 1,2,3,and so on:
(subject 1 gets group 1, 2 get 2 and so on) results in 4 groups of 10 words, randomized
40 words equal 9880 total viewings
120 viewings per subject at 10 words per group
82.33333333 needed subjects for the 9880 total viewing selections

Previously Researched Words

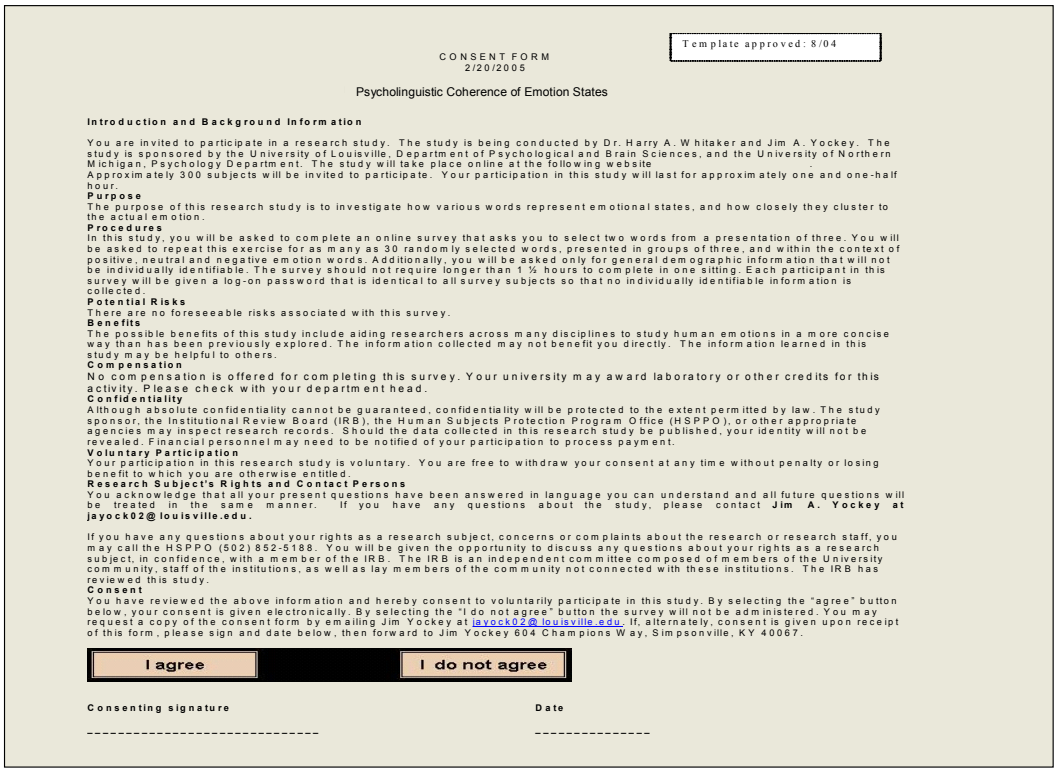
Words from sources now in noted in Appendix

Research Utilized Words	Random # Assigned	Research Utilized Words	Random # Assigned	Research Utilized Words	Random # Assigned	Research Utilized Words	Random # Assigned
1 adoration	139	45 enthrallment	100	89 liking	58	133 uneasiness	130
2 affection	43	46 enthusiasm	119	90 loathing	99	134 unhappines	91
3 aggravation	85	47 envy	66	91 loneliness	62	135 vengefulne	34
4 agitation	17	48 euphoria	26	92 longing	45	136 woe	49
5 agony	36	49 exasperation	81	93 love	10	137 wonder	15
6 alarm	93	50 excitement	121	94 lust	94	138 worry	65
7 alienation	92	51 exhilaration	9	95 melancholy	14	139 wrath	19
8 amazement	84	52 expectancy	24	96 misery	101	140 zeal	102
9 amusement	129	53 fear	125	97 mortification	80	141 zest	33
10 anger	60	54 ferocity	3	98 neglect	67		
11 anguish	39	55 fondness	18	99 nervousness	7		
12 annoyance	118	56 fright	42	100 optimism	97		
13 anxiety	27	57 frustration	126	101 outrage	32		
14 apprehension	108	58 furry	29	102 pain	137		
15 arousal	109	59 gaiety	142	103 panic	88		
16 astonishment	86	60 gladness	22	104 passion	41		
17 attraction	141	61 glee	6	105 pity	117		
18 aversion	135	62 gloom	76	106 pleasure	134		
19 bitterness	46	63 glumness	25	107 pride	89		
20 bliss	106	64 grief	68	108 rage	104		
21 caring	28	65 grouchiness	53	109 rapture	69		
22 cheerfulness	131	66 grumpiness	74	110 regret	78		
23 compassion	113	67 guilt	96	111 rejection	116		
24 contempt	115	68 happiness	37	112 relief	107		
25 contentment	1	69 hate	75	113 remorse	123		
26 courage	138	70 homesickness	70	114 resentment	72		
27 defeat	83	71 hope	47	115 revolution	20		
28 dejection	38	72 hopelessness	127	116 sadness	120		
29 delight	110	73 horror	5	117 satisfaction	21		
30 depression	61	74 hostility	71	118 scorn	40		
31 desire	132	75 humiliation	55	119 sentimentality	128		
32 despair	54	76 hurt	11	120 shame	12		
33 disapointment	103	77 hysteria	13	121 shock	73		
34 disgust	77	78 infatuation	122	122 sorrow	50		
35 dislike	4	79 insecurity	111	123 spite	136		
36 dismay	112	80 insult	56	124 subjection	30		
37 displeasure	35	81 interest	31	125 suffering	87		
38 distress	2	82 irritation	114	126 surprise	63		
39 dread	44	83 isolation	51	127 sympathy	59		
40 eagerness	16	84 jealousy	98	128 tenseness	23		
41 ecstasy	57	85 jolliness	48	129 terror	8		
42 elation	124	86 joviality	52	130 thrill	90		
43 embarrassment	95	87 joy	82	131 torment	105		
44 enjoyment	140	88 jubilation	79	132 triumph	64		

Found these 142 words studied in various research
Randomized all 142 words
Words not segmented by concept emotion,
(positive, neutral, or negative),but by relationship
to positive or negative.

Subjective judgements required to separate by concept emotion.
Words I added to the researched list:
confident
friendly
trusting
impartial
acceptable
calm
cooperative
curious
empathetic
indifferent
disinterested

Survey Presentation Screens



Template approved: 8/04

CONSENT FORM
2/20/2005

Psycholinguistic Coherence of Emotion States

Introduction and Background Information

You are invited to participate in a research study. The study is being conducted by Dr. Harry A. Whitaker and Jim A. Yockey. The study is sponsored by the University of Louisville, Department of Psychological and Brain Sciences, and the University of Northern Michigan, Psychology Department. The study will take place online at the following website . Approximately 300 subjects will be invited to participate. Your participation in this study will last for approximately one and one-half hour.

Purpose

The purpose of this research study is to investigate how various words represent emotional states, and how closely they cluster to the actual emotion.

Procedures

In this study, you will be asked to complete an online survey that asks you to select two words from a presentation of three. You will be asked to repeat this exercise for as many as 30 randomly selected words, presented in groups of three, and within the context of positive, neutral and negative emotion words. Additionally, you will be asked only for general demographic information that will not be individually identifiable. The survey should not require longer than 1 ½ hours to complete in one sitting. Each participant in this survey will be given a log-on password that is identical to all survey subjects so that no individually identifiable information is collected.

Potential Risks

There are no foreseeable risks associated with this survey.

Benefits

The possible benefits of this study include aiding researchers across many disciplines to study human emotions in a more concise way than has been previously explored. The information collected may not benefit you directly. The information learned in this study may be helpful to others.

Compensation

No compensation is offered for completing this survey. Your university may award laboratory or other credits for this activity. Please check with your department head.

Confidentiality

Although absolute confidentiality cannot be guaranteed, confidentiality will be protected to the extent permitted by law. The study sponsor, the Institutional Review Board (IRB), the Human Subjects Protection Program Office (HSPPO), or other appropriate agencies may inspect research records. Should the data collected in this research study be published, your identity will not be revealed. Financial personnel may need to be notified of your participation to process payment.

Voluntary Participation

Your participation in this research study is voluntary. You are free to withdraw your consent at any time without penalty or losing benefit to which you are otherwise entitled.

Research Subject's Rights and Contact Persons

You acknowledge that all your present questions have been answered in language you can understand and all future questions will be treated in the same manner. If you have any questions about the study, please contact **Jim A. Yockey at jayock02@louisville.edu.**

If you have any questions about your rights as a research subject, concerns or complaints about the research or research staff, you may call the HSPPO (502) 852-5188. You will be given the opportunity to discuss any questions about your rights as a research subject, in confidence, with a member of the IRB. The IRB is an independent committee composed of members of the University community, staff of the institutions, as well as lay members of the community not connected with these institutions. The IRB has reviewed this study.

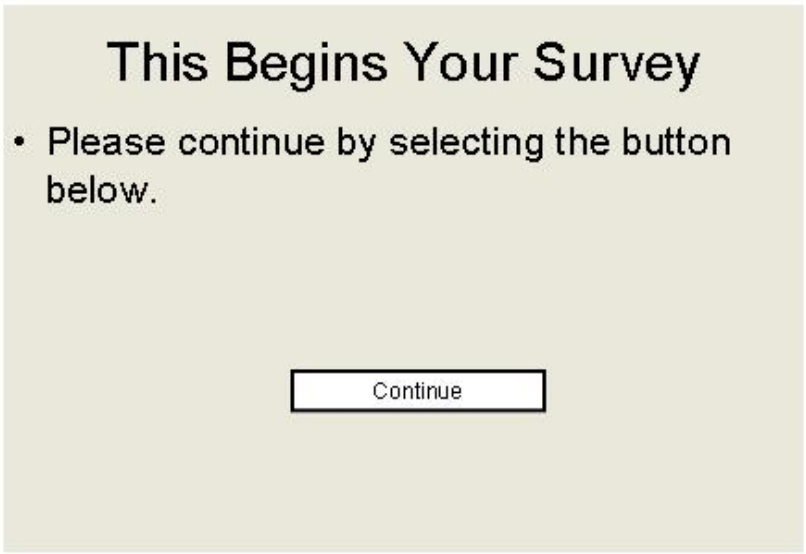
Consent

You have reviewed the above information and hereby consent to voluntarily participate in this study. By selecting the "agree" button below, your consent is given electronically. By selecting the "I do not agree" button the survey will not be administered. You may request a copy of the consent form by emailing Jim Yockey at jayock02@louisville.edu. If, alternately, consent is given upon receipt of this form, please sign and date below, then forward to Jim Yockey 604 Champions Way, Simpsonville, KY 40067.

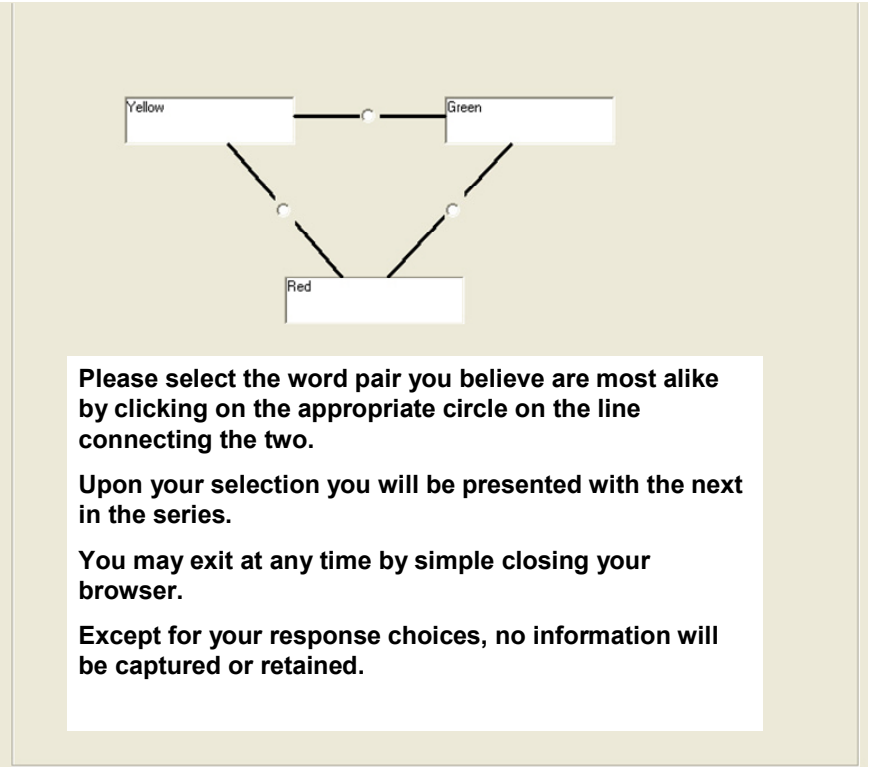
I agree | I do not agree

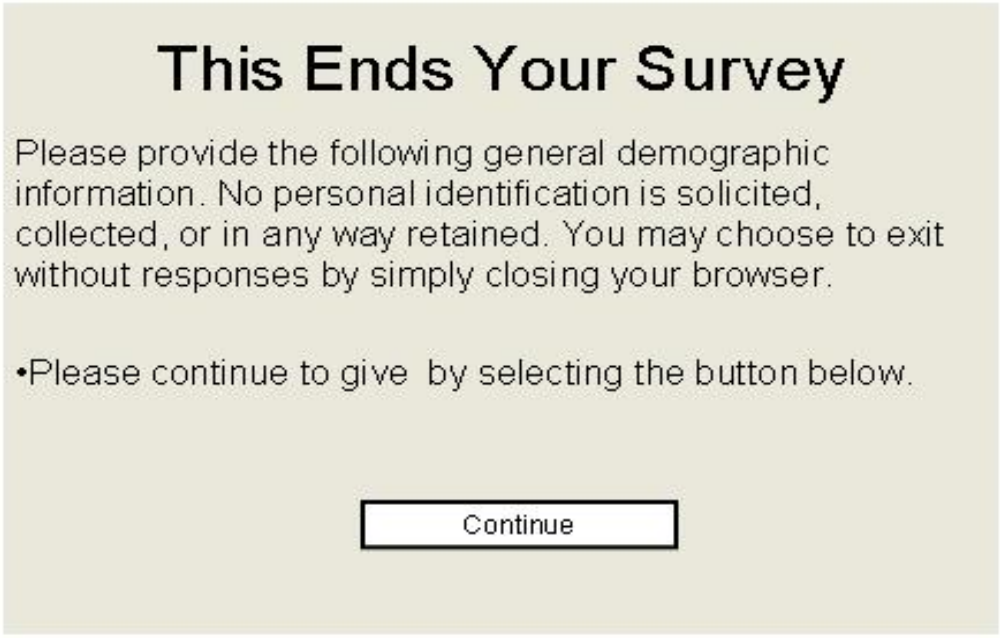
Consenting signature _____

Date _____



Note: The respondent will view 120 screens similar to the following:





Please provide the following general demographic information. No personal identification is solicited, collected, or in any way retained. You may choose to exit without responses by simply closing your browser.

1. Level of education, select one (highest attained):

□ **High School** □ **College** □ **Graduate School** □ **Professional School**

□ **Post Graduate Studies** □ **Ph.D.**

2. If you attended/are attending college, what's your major area?

3. Age range:

□ **Under 20** □ **20-30** □ **31-40** □ **41-50** □ **51 and older.**

4. Gender: □ **Female** □ **Male**

5. Ethnicity: □ **Caucasian** □ **African American** □ **Native American**

□ **Hispanic** □ **Other**

6. Married, or with a steady, permanent partner □ **Yes** □ **No**

7. List special talents or skills (i.e. musical ability, hobbies, etc.):

Please provide the following general demographic information. No personal identification is solicited, collected, or in any way retained. You may choose to exit without responses by simply closing your browser.

8. Are you taking medications routinely that may affect mood or emotions?

□ **Yes** □ **No**

9. Handedness:

In which hand do you typically hold a pen to write? **Right** □ **Left** □

Which hand do you typically use to throw a ball? **Right** □ **Left** □

Which hand do you use for the computer mouse? **Right** □ **Left** □

10. How much sleep did you get last night?

11. Do you smoke? □ **Yes** □ **No**

12. Indicate how you feel right now / today:

□ **Very good** □ **Good** □ **Okay** □ **Poor** □ **Very Bad**

13. Do you typically feel this way?

□ **Yes** □ **No, usually better** □ **No, usually worse**

14. Reading habits: Please rank order 1, 2, 3, 4 (in terms of most frequent, 1 being most often)

newspapers _____

magazines _____

books _____

Computer or Internet _____

Study 1 and Study 2 Completed Statistical Analysis:

Study 1, Proximities-Method Wards Linkage, Measure Manhattan Block
Word Group 1-1:

Proximity Matrix

Case	Matrix File Input									
	angry	anxious	disgusted	excited	happy	loving	nervous	sad	surprising	trusting
angry	.000	103.000	171.000	286.000	348.000	464.000	548.000	604.000	711.000	845.000
anxious	103.000	.000	130.000	189.000	311.000	369.000	493.000	527.000	622.000	750.000
disgusted	171.000	130.000	.000	115.000	195.000	317.000	387.000	473.000	578.000	692.000
excited	286.000	189.000	115.000	.000	140.000	208.000	318.000	382.000	489.000	583.000
happy	348.000	311.000	195.000	140.000	.000	138.000	200.000	310.000	423.000	503.000
loving	464.000	369.000	317.000	208.000	138.000	.000	126.000	198.000	305.000	409.000
nervous	548.000	493.000	387.000	318.000	200.000	126.000	.000	142.000	239.000	333.000
sad	604.000	527.000	473.000	382.000	310.000	198.000	142.000	.000	147.000	265.000
surprising	711.000	622.000	578.000	489.000	423.000	305.000	239.000	147.000	.000	168.000
trusting	845.000	750.000	692.000	583.000	503.000	409.000	333.000	265.000	168.000	.000

Ward Linkage

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	2	51.500	0	0	7
2	3	4	109.000	0	0	7
3	6	7	172.000	0	0	5
4	8	9	245.500	0	0	6
5	5	6	337.167	0	3	8
6	8	10	457.000	4	0	8
7	1	3	596.500	1	2	9
8	5	8	899.500	5	6	9
9	1	5	1625.400	7	8	0

Cluster Membership

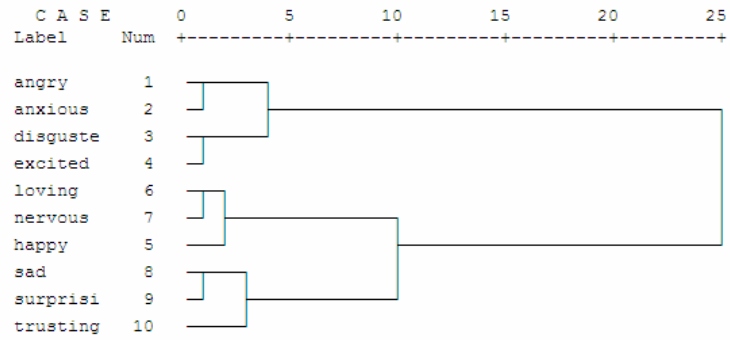
Case	7 Clusters	6 Clusters	5 Clusters
angry	1	1	1
anxious	1	1	1
disgusted	2	2	2
excited	2	2	2
happy	3	3	3
loving	4	4	3
nervous	4	4	3
sad	5	5	4
surprising	6	5	4
trusting	7	6	5

Dendrogram

* * * * * * H I E R A R C H I C A L C L U S T E R A N A L Y S I S * * * * * *

Dendrogram using Ward Method

Rescaled Distance Cluster Combine



Abbreviated Name	Extended Name
disguste	disgusted
surprisi	surprising

Study 1, Word Group 1-2:

Proximity Matrix

Case	Matrix File Input									
	acceptable	cheerful	curious	dejected	hateful	hopeful	horrified	insecure	lonely	sympathetic
acceptable	.000	71.000	168.000	262.000	338.000	397.000	502.000	575.000	665.000	742.000
cheerful	71.000	.000	97.000	191.000	267.000	326.000	431.000	504.000	594.000	671.000
curious	168.000	97.000	.000	104.000	170.000	247.000	352.000	429.000	507.000	594.000
dejected	262.000	191.000	104.000	.000	118.000	165.000	298.000	345.000	453.000	540.000
hateful	338.000	267.000	170.000	118.000	.000	119.000	216.000	277.000	377.000	464.000
hopeful	397.000	326.000	247.000	165.000	119.000	.000	141.000	208.000	294.000	381.000
horrified	502.000	431.000	352.000	298.000	216.000	141.000	.000	173.000	197.000	280.000
insecure	575.000	504.000	429.000	345.000	277.000	208.000	173.000	.000	134.000	221.000
lonely	665.000	594.000	507.000	453.000	377.000	294.000	197.000	134.000	.000	99.000
sympathetic	742.000	671.000	594.000	540.000	464.000	381.000	280.000	221.000	99.000	.000

Ward Linkage

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	2	35.500	0	0	8
2	9	10	85.000	0	0	7
3	3	4	137.000	0	0	6
4	5	6	196.500	0	0	6
5	7	8	283.000	0	0	7
6	3	5	402.250	3	4	8
7	7	9	542.250	5	2	9
8	1	3	782.667	1	6	9
9	1	7	1470.400	8	7	0

Cluster Membership

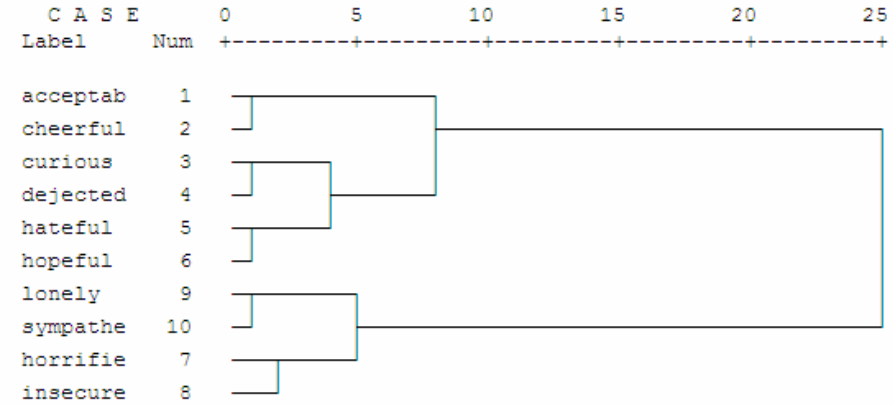
Case	7 Clusters	6 Clusters	5 Clusters
acceptable	1	1	1
cheerful	1	1	1
curious	2	2	2
dejected	2	2	2
hateful	3	3	3
hopeful	4	3	3
horrified	5	4	4
insecure	6	5	4
lonely	7	6	5
sympathetic	7	6	5

Dendrogram

* * * * * * H I E R A R C H I C A L C L U S T E R A N A L Y S I S * * * * * *

Dendrogram using Ward Method

Rescaled Distance Cluster Combine



Study 1, Word Group 1-3:

Proximity Matrix

Case	Matrix File Input									
	affectionate	apprehensive	delighted	disinterested	ecstatic	enthusiastic	joyful	melancholy	resentful	uneasy
affectionate	.000	97.000	211.000	264.000	385.000	477.000	610.000	651.000	744.000	881.000
apprehensive	97.000	.000	114.000	193.000	288.000	390.000	513.000	554.000	647.000	802.000
delighted	211.000	114.000	.000	131.000	222.000	328.000	435.000	500.000	583.000	706.000
disinterested	264.000	193.000	131.000	.000	121.000	217.000	348.000	397.000	480.000	617.000
ecstatic	385.000	288.000	222.000	121.000	.000	136.000	243.000	304.000	365.000	526.000
enthusiastic	477.000	390.000	328.000	217.000	136.000	.000	165.000	218.000	319.000	454.000
joyful	610.000	513.000	435.000	348.000	243.000	165.000	.000	143.000	250.000	361.000
melancholy	651.000	554.000	500.000	397.000	304.000	218.000	143.000	.000	153.000	290.000
resentful	744.000	647.000	583.000	480.000	365.000	319.000	250.000	153.000	.000	173.000
uneasy	881.000	802.000	706.000	617.000	526.000	454.000	361.000	290.000	173.000	.000

Ward Linkage

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	2	48.500	0	0	5
2	4	5	109.000	0	0	6
3	7	8	180.500	0	0	7
4	9	10	267.000	0	0	7
5	1	3	359.167	1	0	8
6	4	6	456.667	2	0	8
7	7	9	641.167	3	4	9
8	1	4	938.167	5	6	9
9	1	7	1700.600	8	7	0

Cluster Membership

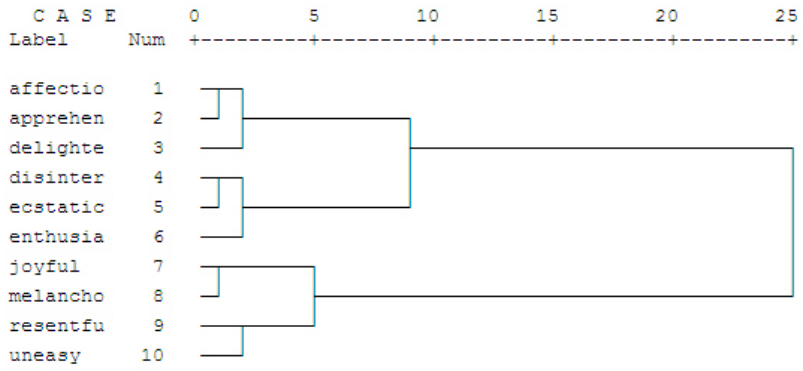
Case	7 Clusters	6 Clusters	5 Clusters
affectionate	1	1	1
apprehensive	1	1	1
delighted	2	2	1
disinterested	3	3	2
ecstatic	3	3	2
enthusiastic	4	4	3
joyful	5	5	4
melancholy	5	5	4
resentful	6	6	5
uneasy	7	6	5

Dendrogram

* * * * * * H I E R A R C H I C A L C L U S T E R A N A L Y S I S * * * * * *

Dendrogram using Ward Method

Rescaled Distance Cluster Combine



Study 1, Word Group 1-4:

Proximity Matrix

Case	Matrix File Input									
	calm	confident	disappointed	fearful	friendly	frustrated	indifferent	irritating	optimistic	passionate
calm	.000	93.000	160.000	216.000	336.000	410.000	475.000	553.000	642.000	715.000
confident	93.000	.000	101.000	139.000	259.000	341.000	400.000	500.000	601.000	652.000
disappointed	160.000	101.000	.000	102.000	194.000	276.000	319.000	411.000	500.000	555.000
fearful	216.000	139.000	102.000	.000	120.000	202.000	261.000	361.000	462.000	521.000
friendly	336.000	259.000	194.000	120.000	.000	110.000	159.000	295.000	390.000	443.000
frustrated	410.000	341.000	276.000	202.000	110.000	.000	119.000	203.000	302.000	389.000
indifferent	475.000	400.000	319.000	261.000	159.000	119.000	.000	144.000	237.000	290.000
irritating	553.000	500.000	411.000	361.000	295.000	203.000	144.000	.000	125.000	240.000
optimistic	642.000	601.000	500.000	462.000	390.000	302.000	237.000	125.000	.000	191.000
passionate	715.000	652.000	555.000	521.000	443.000	389.000	290.000	240.000	191.000	.000

Ward Linkage

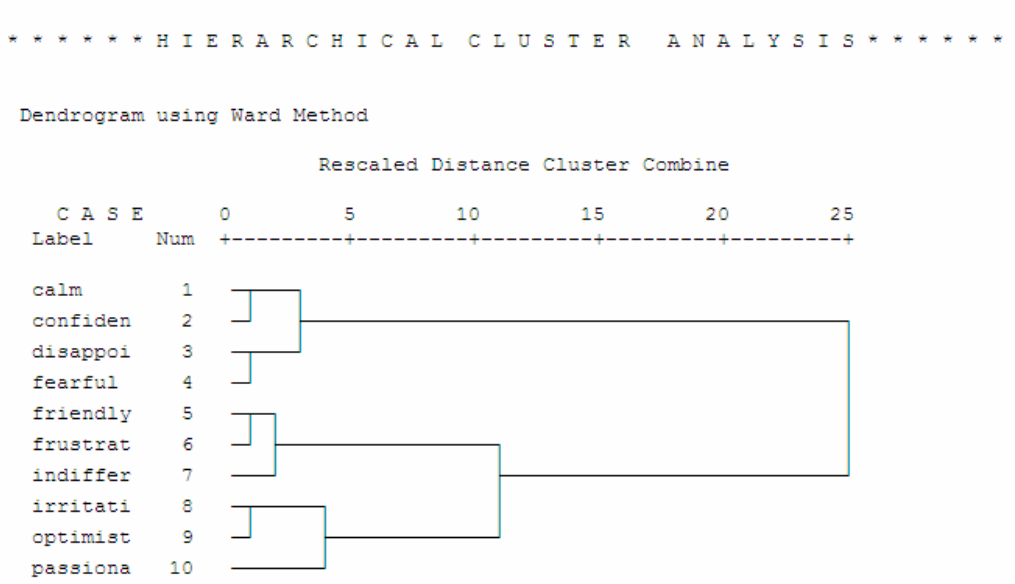
Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	2	46.500	0	0	6
2	3	4	97.500	0	0	6
3	5	6	152.500	0	0	5
4	8	9	215.000	0	0	7
5	5	7	289.333	3	0	8
6	1	3	394.583	1	2	9
7	8	10	517.417	4	0	8
8	5	8	808.917	5	7	9
9	1	5	1451.400	6	8	0

Cluster Membership

Case	7 Clusters	6 Clusters	5 Clusters
calm	1	1	1
confident	1	1	1
disappointed	2	2	2
fearful	2	2	2
friendly	3	3	3
frustrated	3	3	3
indifferent	4	4	3
irritating	5	5	4
optimistic	6	5	4
passionate	7	6	5

Dendrogram



All Study 1 Notes

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	Cases Used	Statistics are based on cases with no missing values for any variable used.
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Case Processing Summary(a)

Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
10	100.0%	0	.0%	10	100.0%

a City Block Distance used

Cluster

Notes

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Study 2, Proximities-Wards Method, Measure Manhattan Block
Word Group 2-1:

Proximity Matrix

Case	Matrix File Input									
	angry	anxious	dejected	disgusted	hateful	horrified	insecure	lonely	nervous	sad
angry	.000	350.000	350.000	308.000	375.000	402.000	307.000	344.000	274.000	346.000
anxious	350.000	.000	346.000	250.000	359.000	288.000	267.000	266.000	312.000	248.000
dejected	350.000	346.000	.000	384.000	219.000	432.000	317.000	352.000	322.000	364.000
disgusted	308.000	250.000	384.000	.000	395.000	266.000	275.000	316.000	310.000	276.000
hateful	375.000	359.000	219.000	395.000	.000	399.000	318.000	363.000	373.000	333.000
horrified	402.000	288.000	432.000	266.000	399.000	.000	343.000	282.000	396.000	320.000
insecure	307.000	267.000	317.000	275.000	318.000	343.000	.000	309.000	301.000	281.000
lonely	344.000	266.000	352.000	316.000	363.000	282.000	309.000	.000	298.000	296.000
nervous	274.000	312.000	322.000	310.000	373.000	396.000	301.000	298.000	.000	328.000
sad	346.000	248.000	364.000	276.000	333.000	320.000	281.000	296.000	328.000	.000

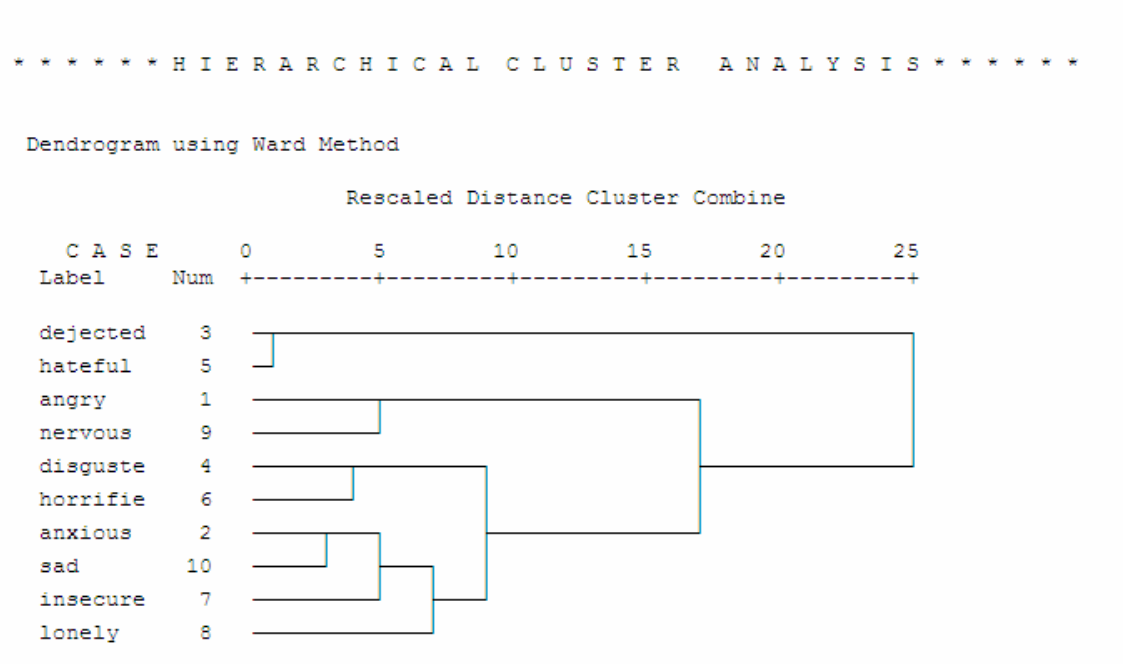
Ward Linkage

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	3	5	109.500	0	0	9
2	2	10	233.500	0	0	5
3	4	6	366.500	0	0	7
4	1	9	503.500	0	0	8
5	2	7	644.833	2	0	6
6	2	8	796.250	5	0	7
7	2	4	960.333	6	3	8
8	1	2	1179.375	4	7	9
9	1	3	1456.000	8	1	0

Cluster Membership

Case	6 Clusters	5 Clusters	4 Clusters	3 Clusters
angry	1	1	1	1
anxious	2	2	2	2
dejected	3	3	3	3
disgusted	4	4	4	2
hateful	3	3	3	3
horrified	4	4	4	2
insecure	5	2	2	2
lonely	6	5	2	2
nervous	1	1	1	1
sad	2	2	2	2



Abbreviated Name	Extended Name
disguste	disgusted
horrifie	horrified

Word Group 2-2:

Proximity Matrix

Case	Matrix File Input									
	apprehensive	disappointed	disinterested	fearful	frustrated	indifferent	irritating	melancholy	resentful	uneasy
apprehensive	.000	83.000	179.000	250.000	294.000	380.000	465.000	528.000	697.000	724.000
disappointed	83.000	.000	96.000	167.000	241.000	321.000	382.000	471.000	614.000	641.000
disinterested	179.000	96.000	.000	131.000	205.000	279.000	338.000	407.000	536.000	597.000
fearful	250.000	167.000	131.000	.000	134.000	204.000	299.000	376.000	467.000	552.000
frustrated	294.000	241.000	205.000	134.000	.000	130.000	201.000	254.000	411.000	452.000
indifferent	380.000	321.000	279.000	204.000	130.000	.000	151.000	198.000	399.000	446.000
irritating	465.000	382.000	338.000	299.000	201.000	151.000	.000	107.000	308.000	309.000
melancholy	528.000	471.000	407.000	376.000	254.000	198.000	107.000	.000	235.000	276.000
resentful	697.000	614.000	536.000	467.000	411.000	399.000	308.000	235.000	.000	147.000
uneasy	724.000	641.000	597.000	552.000	452.000	446.000	309.000	276.000	147.000	.000

Ward Linkage

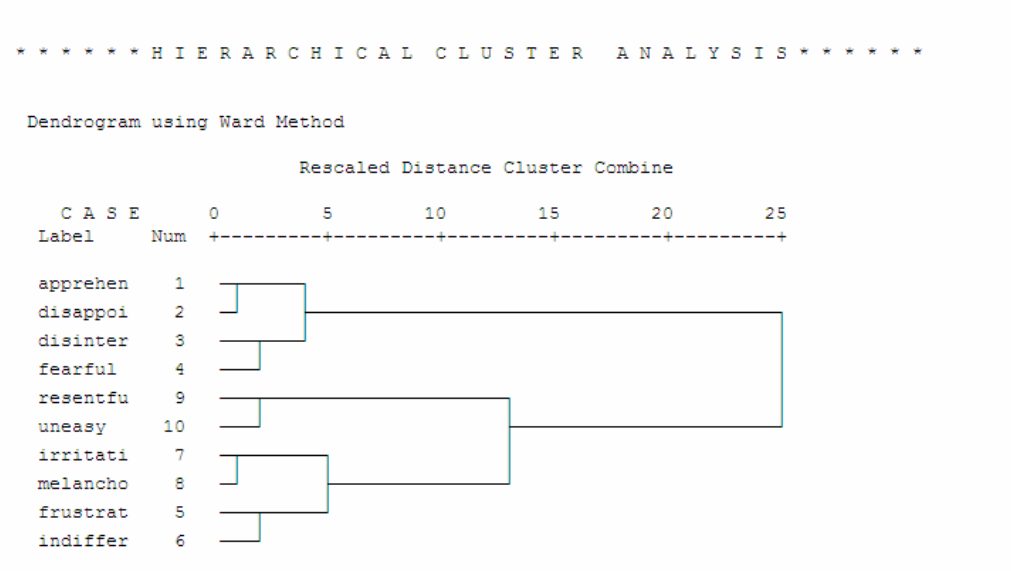
Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	2	41.500	0	0	6	
2	7	8	95.000	0	0	7
3	5	6	160.000	0	0	7
4	3	4	225.500	0	0	6
5	9	10	299.000	0	0	8
6	1	3	418.500	1	4	9
7	5	7	560.250	3	2	8
8	5	9	897.167	7	5	9
9	1	5	1508.200	6	8	0

Cluster Membership

Case	6 Clusters	5 Clusters	4 Clusters	3 Clusters
apprehensive	1	1	1	1
disappointed	1	1	1	1
disinterested	2	2	1	1
fearful	2	2	1	1
frustrated	3	3	2	2
indifferent	3	3	2	2
irritating	4	4	3	2
melancholy	4	4	3	2
resentful	5	5	4	3
uneasy	6	5	4	3

Dendrogram Word Group 2-2



Abbreviated Name	Extended Name
apprehen	apprehensive
disappoi	disappointed
disinter	disinterested
frustrat	frustrated
indiffer	indifferent
irritati	irritating
melancho	melancholy
resentfu	resentful

Word Group 2-3:

Proximity Matrix

Case	Matrix File Input									
	affectionate	delighted	ecstatic	enthusiastic	excited	happy	joyful	loving	surprising	trusting
affectionate	.000	106.000	226.000	259.000	427.000	559.000	533.000	746.000	806.000	778.000
delighted	106.000	.000	120.000	245.000	321.000	453.000	467.000	640.000	700.000	748.000
ecstatic	226.000	120.000	.000	175.000	309.000	333.000	407.000	554.000	580.000	640.000
enthusiastic	259.000	245.000	175.000	.000	238.000	300.000	284.000	487.000	547.000	519.000
excited	427.000	321.000	309.000	238.000	.000	180.000	280.000	479.000	553.000	533.000
happy	559.000	453.000	333.000	300.000	180.000	.000	206.000	359.000	405.000	435.000
joyful	533.000	467.000	407.000	284.000	280.000	206.000	.000	265.000	331.000	415.000
loving	746.000	640.000	554.000	487.000	479.000	359.000	265.000	.000	204.000	492.000
surprising	806.000	700.000	580.000	547.000	553.000	405.000	331.000	204.000	.000	314.000
trusting	778.000	748.000	640.000	519.000	533.000	435.000	415.000	492.000	314.000	.000

Ward Linkage

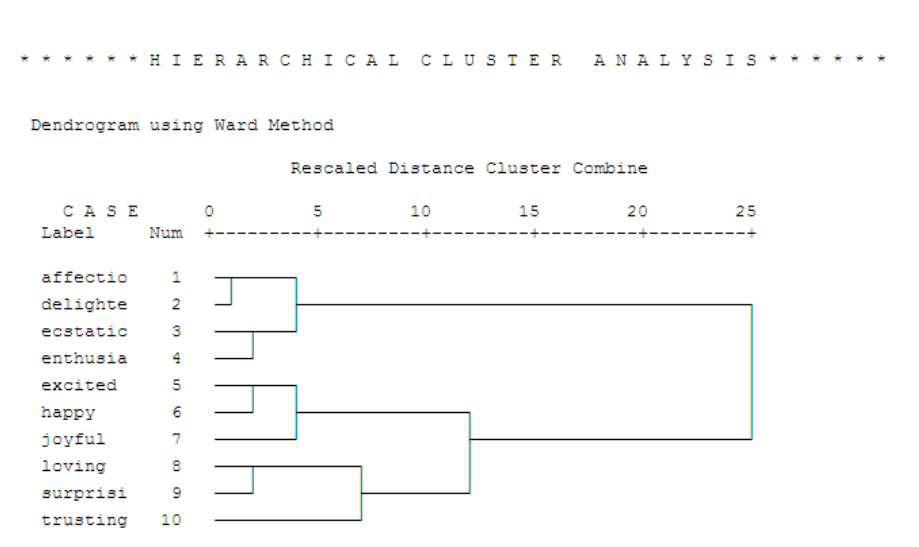
Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	2	53.000	0	0	6
2	3	4	140.500	0	0	6
3	5	6	230.500	0	0	5
4	8	9	332.500	0	0	7
5	5	7	464.500	3	0	8
6	1	3	606.750	1	2	9
7	8	10	841.417	4	0	8
8	5	8	1191.250	5	7	9
9	1	5	1895.800	6	8	0

Cluster Membership

Case	6 Clusters	5 Clusters	4 Clusters	3 Clusters
affectionate	1	1	1	1
delighted	1	1	1	1
ecstatic	2	2	1	1
enthusiastic	2	2	1	1
excited	3	3	2	2
happy	3	3	2	2
joyful	4	3	2	2
loving	5	4	3	3
surprising	5	4	3	3
trusting	6	5	4	3

Dendrogram (Word Group 2-3)



Word Group 2-4:

Proximity Matrix

Case	Matrix File Input									
	acceptable	calm	cheerful	confident	curious	friendly	hopeful	optimistic	passionate	sympathetic
acceptable	.000	94.000	184.000	299.000	517.000	565.000	601.000	639.000	762.000	835.000
calm	94.000	.000	90.000	205.000	423.000	471.000	507.000	551.000	762.000	785.000
cheerful	184.000	90.000	.000	115.000	333.000	381.000	417.000	469.000	680.000	731.000
confident	299.000	205.000	115.000	.000	218.000	294.000	340.000	448.000	609.000	662.000
curious	517.000	423.000	333.000	218.000	.000	316.000	196.000	290.000	459.000	532.000
friendly	565.000	471.000	381.000	294.000	316.000	.000	306.000	166.000	363.000	438.000
hopeful	601.000	507.000	417.000	340.000	196.000	306.000	.000	270.000	363.000	446.000
optimistic	639.000	551.000	469.000	448.000	290.000	166.000	270.000	.000	255.000	330.000
passionate	762.000	762.000	680.000	609.000	459.000	363.000	363.000	255.000	.000	185.000
sympathetic	835.000	785.000	731.000	662.000	532.000	438.000	446.000	330.000	185.000	.000

Ward Linkage

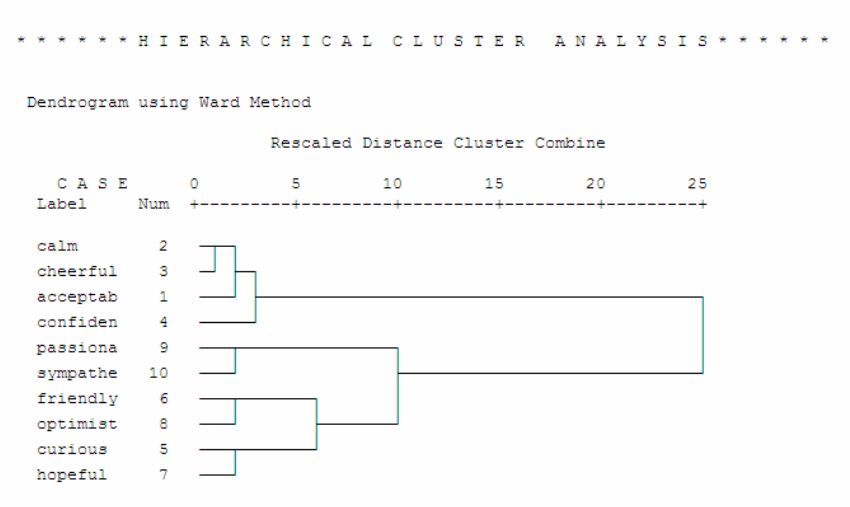
Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	2	3	45.000	0	0	2
2	1	2	122.667	0	1	6
3	6	8	205.667	0	0	7
4	9	10	298.167	0	0	8
5	5	7	396.167	0	0	7
6	1	4	520.250	2	0	9
7	5	6	725.250	5	3	8
8	5	9	1065.917	7	4	9
9	1	5	1890.200	6	8	0

Cluster Membership

Case	6 Clusters	5 Clusters	4 Clusters	3 Clusters
acceptable	1	1	1	1
calm	1	1	1	1
cheerful	1	1	1	1
confident	2	2	1	1
curious	3	3	2	2
friendly	4	4	3	2
hopeful	5	3	2	2
optimistic	4	4	3	2
passionate	6	5	4	3
sympathetic	6	5	4	3

Dendrogram (Word Group 2-4)



Abbreviated Name	Extended Name
acceptab	acceptable
confiden	confident
optimist	optimistic
passiona	passionate
sympathe	sympathetic

Notes:

Proximities

Notes

Output Created		27-NOV-2005 17:41:05
Comments		
Input	Data	C:\Documents and Settings\Owner\My Documents\Grad School\Thesis\Final Thesis Documents\Data\Study 2\Final Data\s2 g1 data.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	10
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		PROXIMITIES group dependent /MATRIX OUT ('C:\DOCUME~1\Owner\LOCALS~1\Temp\spss8288\spssclus.tmp') /VIEW= VARIABLE /MEASURE= BLOCK /PRINT NONE /STANDARDIZE= NONE .
Resources	Elapsed Time	0:00:01.62
	Workspace Bytes	560
Files Saved	Matrix File	C:\DOCUME~1\Owner\LOCALS~1\Temp\spss8288\spssclus.tmp

Case Processing Summary(a)

Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
10	100.0%	0	.0%	10	100.0%

a City Block Distance used

Cluster

Notes

Output Created		27-NOV-2005 17:41:06
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	10
	Matrix Input	C:\DOCUME~1\Owner\LOCALS~1\Temp\spss8288\spssclus.tmp
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		CLUSTER /MATRIX IN ('C:\DOCUME~1\Owner\LOCALS~1\Temp\spss8288\spssclus.tmp') /METHOD WARD /PRINT SCHEDULE CLUSTER(3,6) /PRINT DISTANCE /PLOT DENDROGRAM VICICLE.
Resources	Elapsed Time	0:00:00.16

Curriculum Vitae

Jim A. Yockey is a graduate of the University of Phoenix with a B.A. in Management, having attended the University of Texas at El Paso (Economics). Mr. Yockey holds a Certified Financial Planner designation from the College for Financial Planning in Denver and has spent 25 years in financial services. He has published two books, Money Moves and Road Map to Wealth.

During his career in the investment business, Mr. Yockey held executive positions for several major mutual fund and insurance companies and has spent several years consulting in the field. While seeking empirical research for his third book, Mr. Yockey became a full time graduate student at the University of Louisville in the Psychological and Brain Sciences department. Upon completion of this thesis he expects to Graduate with a Masters in Psychology from the University.